ENGINEERING & MINING JOURNAL-PRESS

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Heap Leaching of Low-Grade Copper Ores—I

By Joseph Irving

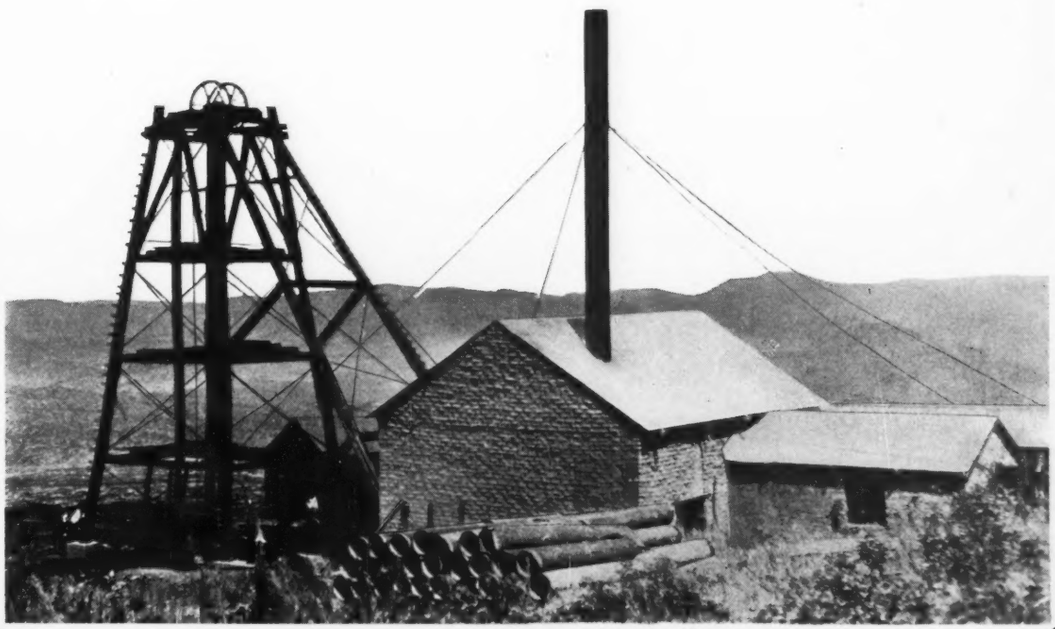
The Constancia Mining Properties in Coahuila, Mexico

By S. F. Shaw

The Trade Association and the Mining Industries

By Felix Edgar Wormser

Biography of Walter McDermott



An adobe hoist house in the Sierra Mojada district, Coahuila, Mexico

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

April 29, 1922

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The European Chessboard

THE TREATY signed at Rapallo between Germany and Russia is more than the drawing together of the "two Ishmaelites among nations." It is true that European diplomacy makes strange bed-fellows. There is nothing stranger to contemplate than the chumming together of highly capitalistic Germany and anti-capitalistic Russia. But deeper than theories of political economy and of government is economic necessity. The constructive thought of Germany ever since her military defeat has turned toward Russia as her only hope of regaining her pre-war power. A wall shuts her in on the West, South, and North; but in exploiting the vast resources of Russian territory and in organizing a broken and spent people, her thinkers, true to their pre-war type, foresee a possible future greater than that which she lost. We are publishing a review of a German book, just issued, the conclusion of which is that Germany must look to Russia's iron and manganese reserves, in the future, for the support of her steel industry.

On the other hand, Russia and her leaders are at the end of their rope. They must have increased prestige and outside help at once. They have appealed to America, but find no recognition here. They look to England, but the terms are stiff. Better Germany than nothing; and besides, they think, the spectacle of a German alliance should make it easier for them to deal with the former Allies.

Government Co-operation in Quoting Metal Prices

THE CURRENT metal price quotations, especially those of copper, lead, and zinc, which for so many years have been officially established by *Engineering and Mining Journal*, will be further safeguarded by co-operation with the Government. An arrangement has been effected whereby a Government official, representing both the Interior and Commerce Departments, will co-operate in this work with the market editors of the *Journal-Press*. Thus a co-operative service between the Government, the industries, and the press is effected, that should be beneficial to all three.

The Government representative is Mr. H. S. Mulliken, of the Bureau of Mines, who will represent, besides the Bureau of Mines, the United States Geological Survey and the Bureau of Foreign and Domestic Commerce.

The Edge Trade Association Legislation

THE DILEMMA in which trade associations find themselves as the result of the Hardwood decision continues to be the subject of much discussion. The most recent developments include the Hoover conference at Washington and the introduction, in Congress, of a tentative bill by Senator Edge placing such associations under the Federal Trade Commission, and of a joint resolution, fathered by Senator Edge and Representative McArthur, providing for a Congressional investigating committee.

"Business is entitled to know in definite terms what it may and may not do," declares the preamble of the proposed joint resolution. This declaration will strike a sympathetic chord in many a weary heart. For fifty years American business has been struggling to attain certainty in its legal status. Ever since the first halting steps in great combination movements, legal uncertainty has been an ever-present condition. Under the old common-law doctrines, under the state anti-trust laws, and under the Federal Sherman Act, business has been operating under the handicap of indefinite and negative restrictions. The process has been one in which business, denied definite positive guidance, has tentatively adopted in its tendency toward combination one legal form after another—the pool, the trust, the holding company, the merger—only to be checked and turned back by the Supreme Court, which has finally evolved that marvel of indefiniteness—the "rule of reason." The latest decisions have made it clear that combinations in restraint of trade cannot be erected under the guise of open-price associations. One more experiment tried and the check once more applied!

Business now asks for a statement of what it can do. It demands an opportunity to submit plans for trade-association activities to the Federal Trade Commission for approval or disapproval before operations are begun.

The uncertainty which has been present has been costly in the past—much more costly than is ordinarily realized. If one were to attempt to devise a plan for dampening business enterprise, it would be difficult to evolve a more efficient implement than a threat of illegality. This type of uncertainty is a perfect wet blanket.

We do not mean to infer that business should be left free to do anything it chooses. So long as competition is the force relied upon to protect consumers from high prices, it will be necessary to prevent by law combinations in restraint of trade. We merely point out that certainty as to what is legal and what is illegal would greatly simplify the problem of the business man. How can one proceed confidently so long as the rules of the game are undetermined and constantly shifting?

In this particular case, moreover, uncertainty is likely to be exceptionally costly. Unless positive guidance is given, the trade-association movement will receive a blow which will prevent in large measure the performance of many functions which are highly useful in the economic process and quite free from objection on the ground of restraint of trade. For the fact-finding function of the trade association is really a risk-elimination function. If a business man can make his plans and decisions on the basis of fact and knowledge rather than guess and speculation, he can price more closely,

eliminating the reserves and insurance premiums which inevitably accompany the conduct of business when surrounded by uncertainties. Trade associations now supply many valuable data; they can be so developed as to supply many more. Such data are essential to wise business decisions and will result in fewer losses to business men and lower prices to consumers.

The Edge bill may not be perfect. Senator Edge does not pretend that it is. But certainly his proposals are steps in the right direction. It is possible to define fairly precisely the things which trade associations "may and may not do," and Congress owes it to the business community and to the country to make this clear.

A Lesson in Management

THE RECENT DECISION of the directors of the Tintic Standard Mining Co. to pass another quarterly dividend has aroused much speculation as to the condition of the company's affairs. Although no explanation accompanied the public announcement, we happen to know some of the facts. The mine, in the North Tintic district in Utah, contains large deposits of rich lead-silver-copper ore in limestone beds. It is a "young" mine, the first ore having been shipped only about five years ago. Since then dividends amounting to $1,715,000 have been distributed and an expensive milling plant and a standard-gage railroad from the mine to the mill, a distance of about ten miles, have been built at a cost said to have been nearly a million. All of this came from proceeds of the sale of ore.

A mine, however, can be overworked; it can be abused; and this is what was done to the Tintic Standard mine. The only concern of the management seemed to be the maintenance of current production. When the mill was completed, early in 1921, about four hundred tons of medium-grade ore was shipped daily in addition to the smelting ore. This necessitated the extension of the stopes from which the high-grade ore had already been taken, and the open areas became larger than ever.

The ground was "good" from the miners' standpoint, and huge square-set stopes were left unfilled. Finally, warning came in the form of several costly caves; others were imminent, and one of the shafts was threatened. It became apparent that a serious mistake had been made in allowing the stopes to remain virtually unfilled. The management realized, what it should have known all along, that the function of timbers in a mine is to serve as a scaffold from which miners may work; to afford temporary protection, and to maintain necessary passageways; they should not be expected permanently to support mine workings, particularly where the orebodies are large, as they are in the Tintic Standard.

For some months now many hundreds of tons of waste have been poured daily into the old stopes, and, we understand, danger of disaster is past. A new policy has been formulated; the greatest ultimate profit will be obtained from the property by doing systematic, if somewhat slower, mining. The mine will be put in good physical condition and will be kept that way. A disproportionately large expenditure will be necessary for some time, but in reality a considerable part of the current mining cost is a deferred charge on ore that was shipped many months ago.

Naturally, earnings have been decreased, and the decrease has been reflected in the passing of dividends and the decline of the price of shares on the exchange. We are informed, and we have every reason to believe, that the reserve of proved ore is exceptional and that the outlook for the future is excellent. A lesson has been learned; it was expensive, but lessons that are not expensive frequently are easily forgotten.

Increasing the Use of Copper

PROBABLY the most constructive work which has been done looking toward an improvement in the demand for copper has been that of the Anaconda Copper Mining Co. in putting copper roofing shingles on the market. For some months past a large amount of research work has been done, two of the chief problems being, first, to perfect a suitable joint which would be leak and wind proof, allow expansion, and be easy to put together; and, second, to produce a finish which would be artistic. Both of these requirements seem to have been met in the Anaconda product. The crimped edge by means of which the shingles are fitted together is both cheap to manufacture and satisfactory to use and the oxidized greens, reds, and browns obtained by subjecting the shingles for varying length of time to nitric acid are not only beautiful but considerably more permanent than paint. Of course, copper naturally oxidizes to an attractive color, but by this process the effect is obtained even before the roof is laid.

During the last month the Anaconda company has carried several large advertisements in the *Times* and other New York newspapers, calling the attention of the general public to the economy and beauty of the company's product. The response has been large. Coming just at the time when builders are beginning to make up for lost time, thousands of people are interested. A large show room is being fitted up at 25 Broadway, and a house at South Orange, the first to be roofed with the new material, has attracted great attention. Later, it is planned to extend the publicity campaign to other sections of the country. The singles are ready for delivery from the Perth Amboy works and will be sold direct to the user in large or small quantities.

It is of interest to note that whereas the copper roofing sells for from $22 to $25 per hundred square feet, zinc shingles made in the same way can be had for half that price. Properly laid, either one should last a lifetime or more, and the only reason for the use of copper would seem to be its greater beauty. The zinc shingles, though obtainable in an oxidized finish, nevertheless cannot be toned to a desired color, but remain a silvery white or light slate color.

The New Jersey Wire Cloth Co., which markets the Roebling product, is also conducting a national advertising campaign in the *Literary Digest* and other publications, for copper screen cloth. Much of the copper screening formerly sold has been in reality bronze, whereas the new product is 99.8 per cent copper, specially processed to give additional strength. Not only has the aim been to make a superior product, but to avoid charging extortionate prices. Inquiry at the local warehouse developed the fact that ordinary insect screening made of No. 14 copper screen cloth could be obtained even in small quantities for 8¾c. a square foot.

The Rome Brass & Copper Co. is continuing its campaign for the wider use of copper kitchen utensils. One of the company's practical ideas has been to give every buyer of a Monarch range a set of copper pots and pans.

These companies are all doing their share to put the copper publicity movement on a practical basis. The work of the Copper & Brass Research Association is no less real, but is less apparent. The name of this organization is unfortunate. To engineers it is misleading, for no research work, in the technical meaning of the word, is done. It is purely a publicity organization, and its work so far has been, generally speaking, to find out, by conversations, reading, and correspondence, what copper is good for and what it is not good for, and to put the truth before as many people as possible. Being financed by a large number of producers and fabricators, care must be taken to play no favorites and not to push any one company's product unduly. Little can be done in the matter of price control without running the risk of Government interference. The work of the association is therefore a kind of moral suasion.

That the use of copper can be stimulated there is little doubt. We do not expect a sudden and largely increased demand, although the possibilities of the radio telephone must be considered. Nothing that any producer or manufacturer or group of either can do is likely to result in every copper mine working to capacity in the next two or three years. However, a very real increase in the demand can be obtained by intelligent effort such as the companies already mentioned are making. The building industry offers possibly the greatest prospect of an immediate outlet. Roofing, screens, piping, and the other things that go into a house can be made to absorb a lot of copper. It only remains to advertise the economy of copper and brass for these uses and to pay particular attention to marketing problems. Copper products must be easy to obtain and must be sold at a reasonable price compared to other metals. Because copper screws will last four times as long as iron screws is no reason to sell them for three times the price, and then to preach the economy of their use. They actually cost less to manufacture than do iron screws, and they should be sold certainly at no advance.

Care must be taken, also, not to try to invade fields in which other metals are rightly established as being superior. Zinc, aluminum, nickel, and other metals have established reputations for certain purposes in which they are probably economically preferable to copper. It is as a substitute for iron that copper has the greatest possibilities, and we say this with no apology to our friends in the iron industry. This country produces about ten times as much iron as copper, and the demand for copper could be doubled at the expense of the commoner metal without inflicting any appreciable hardship on the iron industry.

Drift to State Socialism

FREEDOM OF INITIATIVE and legislative machinery for the speedy enactment of wise, unwise, and even pernicious laws work out in a curious way. The North Dakota debacle is a case in point. The proposed Five Hundred Million Dollar Power Bill which is now under discussion in California and which no doubt will be submitted to the vote of the people of that state is another example of socialistic trend. The proposed bill has for its object the conservation, development, and control of the water powers of the state for the use and benefit of the people. A board of five men to be appointed by the Governor is to administer its provisions. Almost unrestricted power is to be given this board. To all intents and purposes it can embark on any business. Bonds to the amount of $500,000,000 are to be issued to carry out the provision of the bill. The bonds are to be in fact a first mortgage upon the state.

There are two fundamental objections to this unwise proposal. California has already a great system of hydro-electric plants which cover the state with a network of transmission lines, adequately and equitably serving a vast number of consumers. These plants are privately owned and represent an investment of $500,000,000 and have a total capacity of 1,200,000 hp. There is a surplus of power ready for the market. The entire system is closely regulated by the State Railroad Commission. Power and lighting rates are on as reasonable a basis as in any other state. The service is dependable.

The entrance of the state as a competitor in the existing market will result in a degradation of the private capital already invested and will destroy the confidence of investors in business enterprises in the state. The existing wealth of California has been largely the result of private capital put into mines, farms, orchards, and business generally. To change this principle fundamentally is to invite disaster. To relegate immense power to an oligarchy of five men is to strike at the roots of democracy.

The second fundamental objection is an inevitable and almost unrestricted increase in taxation. The $500,000,000 and interest will have to be paid by the people of the state either directly as taxes or indirectly in rates for service. The isolation of $500,000,000 of wealth from taxes merely increases the tax upon all other wealth. The advocates of this bill make the insidious argument that the profits of the state-owned enterprises will pay the bills, but carefully conceal the fact that the people pay these profits, for there is no one else to pay. During the last ten years, the expenditures of the state government have increased 243 per cent as compared with an increase of 40 per cent in population and an increase of 60 per cent in wealth.

In view of the well-established and wisely controlled public-service corporations made possible by private investment, this move to embark upon state-owned and state-controlled power plants seems to us to be unwise and to strongly invite financial disaster, not only to many innocent investors but to the state as a whole.

Boston & Montana Again

BOSTON & MONTANA has been thrown into public notice more than ever by the publication of the results of the Herzig report and the withdrawal of Harris & Co. from acting as brokers for the sale of its stock. We hear that legal proceedings have been instituted against Mr. Herzig and others, the implication being that his report was made to depress the stock in the market.

We are no more favorably impressed with these methods of the Boston & Montana Co. than we have been with its promotion methods in the past. If the company wishes to refute the Herzig report, it should do it with engineers, not lawyers. It is customary to have a mining engineer determine a mine's resources and future possibilities. So far as we know, Boston & Montana has not published a complete and calculated statement of ore reserves. To establish confidence, it should have such an estimate made at once by an engineer of unquestioned standing. Otherwise, its position must remain unfavorable in the eyes of the investing public.

The Functions of Institutes—III

By T. A. Rickard

MY LAST article on this subject ended with a reference to a Mining Congress. This prompts further mention of the American Mining Congress, which, after many vicissitudes, has achieved success as a permanent lobby established at Washington for the purpose of protecting the mining industry from adverse legislation. It is also a parliament of mining men, for its annual conventions are well attended and serve to render articulate the ideas of those engaged in mining, more particularly those of the big operators and the representatives of the principal mining companies, that is, of those on whose financial support the Congress depends for its existence. The chief factor in its success has been its permanent secretary, Mr. James F. Callbreath, a man of good sense and untiring energy. The Mining Congress performs its two functions, as a lobby and a general convention, so well that it is a pity it should have started to indulge in a cheap kind of journalism, the chief features of which are puffs and piffle. Moreover, it is endeavoring to meet the cost of its incursion into the publishing business by soliciting advertising, and to do that it is compelled to rely upon a false inference, namely, the statements that its members are 'subscribers' to its monthly 'Journal'. The same thing is done by the American Institute, which likewise issues a second-rate monthly magazine that is supported partly by the dues of the members and partly by advertisements. The latter are obtained by two devious methods, first, the statement that the members are 'subscribers', and, second, the employment of advertising agents who are quick to make the most of the coincidence that many of the leading managers of mines and smelters are directors of the Institute, and therefore persons whom the manufacturer would like to please. If the Institute and the Congress were to place a subscription price on their publications, as the Canadian Institute has done until recently, they would not impose upon the members that do not desire these publications, but even then they would be engaging in a business entirely foreign to their *raison d'être*. It is no part of the province of such organizations to engage in buying and selling—in purely commercial enterprise. It would be quite as proper for them to run assay-offices, reduction works, or livery-stables. Their journalism is of the 'kept' kind, because it is controlled by persons engaged in the affairs on which they comment. Of such journalism there is too much already; and not only because it is superfluous, but because it is spurious. The Institute magazine and the Congress journal are not independent publications, by any means; both are dominated by small coteries that control our large mining enterprises. The Canadian Institute is drifting that way, for as soon as it becomes a congress of mining men it will have to depend upon the financial support of a small group of rich men or of men representing rich companies. Indeed, it is inevitable for the control of large organizations to become centralized in the hands of a few, simply because centralization is the easiest way to obtain a concentrated management. This management, particularly the paid officials, like many other people, desires to have a house organ; that is, a periodical publication in which it can ventilate its opinions. The publication is also a convenience to sundry members, chiefly resident near headquarters, who have propaganda of their own. And yet the claim is made that the Institute 'Magazine' is an 'independent' organ of opinion, and representative of the membership. On the contrary, it is a publication subsidized by the directors and wished upon the membership. That it is a menace to independent technical journalism is manifest; indeed, the Institute has issued circulars recently in which the passing of the 'Mining and Scientific Press' is used as an argument in soliciting 'professional cards' from consultants. On this I shall remark that the technical press was largely influential in starting, developing, and supporting the Institute; that the commercial contest between them now being waged is highly detrimental to the profession; nay more, as I am no longer a publisher, I do not hesitate to say that if the mining profession is to choose between an independent technical journalism and the misuse of the powers of the Institute, it will know what to do. The mining industry and the mining profession will lose more—it will lose more, I repeat—by killing independent journalism than by losing the Institute itself.

On the other hand, the Mining and Metallurgical Society has escaped most of these pitfalls by remaining a professional organization, by curtailing its publishing activities, and by restricting itself to the performance of its proper functions. So has the Institution in London. Indeed the only reason why the Society has not replaced the American Institute is its exclusiveness, which has caused it to fail as a representative of the mining-engineering profession in the United States. That defect can be remedied at any time, whereas the nondescript inclusiveness of the Institute cannot be corrected except by the slow substitution, by death and resignation, of the fit for the unfit. In short, the Institute occupies a position between a technical society and a congress; it will have to elect which it is to be. The time has come to consider these questions seriously; the mining profession will make an irremediable blunder if it ignores them. I write on my own initiative, without prompting from anybody, but as one familiar with the organization and management of the technical societies in the English-speaking countries. The mining profession needs to have an organization of its own, for the preservation and development of its code of conduct, its solidarity, and its ideals. The War and the no less serious period since the War have shown how the mining engineer can serve the public and the Nation. The great industrial conflicts of our time—more particularly the quarrel between Capital and Labor—will not be solved for the good of our country unless the engineers, who are the managers and consultants for the companies that control industrial enterprise, are independent, intellectually honest, and humane. To be that they need the stimulus of coming together, of comparing notes, and of exchanging experience. The remedy for the present unsatisfactory condition of the Canadian and American Institutes, particularly the latter, because it is the one in which the majority of my readers are interested, is a frank discussion. With the Editor's permission, I invite such discussion for publication in the 'Journal-Press'.

DISCUSSION

Deflating Mining Engineers

Caustic Observations Respecting the Obliquity of the Black Sheep of the Profession

THE EDITOR:

Sir—Rising to a question of personal privilege in the *Engineering and Mining Journal-Press* of April 8, "The Guilty One" confesses to having been particeps criminis to an arrangement whereby the management of two mines was taken over for the salary of $200 per month and "find yourself"—including a business office.

Careful business men—not inexperienced in mining, he explained—took advantage of the fact that "there are so many mining engineers unemployed." Being predisposed toward "economy"—and deflation being the order of the day—the Boston directors must have observed that the nut crop is the largest of recent years—and nuts are both meat and dessert for those seeking vitamines, or their equivalent. Hence an inexplicable optimism on the part of "The Guilty One," who, while deprecating the inclusion of mining engineers in the liquidating movement, inconsistently expects the tape to immediately reflect an advance in the price of engineers as a commodity, from $200 to $201½. Manifestly, he should have debited the $200 with the office rent. Instead of a bull market, it is "a bear"—there is more "distress" commodity overhanging, and quotations may not have found their level.

This does not commend "experienced business and mining men" of Boston, who might have exacted a subscription to the working capital before taking on a line of technical stuff. New England undoubtedly has Down-East ca'canniness. The trouble is, even Agassiz left a collection of lithographs among his papers—and when Boston is depressing quotations for mining engineers it may be setting other really wasteful precedents, notwithstanding "The Guilty One" no doubt has professional pride, ability, and an educational pedigree.

Not long ago, other New Englanders ventured afield—not to Utah and Nevada. Under the leadership of a historic professional business man, who years ago introduced the "Boston Blacksmith" to the footlights, they retained or were retained by an "engineer," who represented a property that was said to be triple-plated. What was not precious metal was not worth mentioning. The "engineer" became general manager; the New England pugilistic impresario—unrecognized by moderns of the profession — went on circuit. Somehow the dollars did not roll with the requisite rhythm. The managing director in New England sent a series of S.O.S.'s for jazzy news from the mine, and "samples—no matter where they come from." It was a mere detail whether or not the samples were taken from the triple-plated treasure vault. A bear market in experts and shares necessitated the fanciest exhibit obtainable—from private specimen cases, or elsewhere, so long as it was high grade.

Wires were kept warm. Rush messages and their pernicious portent, as one newspaper asserts, brought resentment from the engineer on the spot. He wearied of effort without reward; and then he published the telegrams, for which he was hailed as an exemplar. The New England managing director was exposed. His duplicity deserved it. But not a word has appeared about the record of the self-adulatory "engineer," who has been in durance on sundry occasions, and who was in compulsory retirement for a period in a western Canadian institution. He was the sort of "engineer" upon whom prosecuting authorities of late have had their stop-watches. His class has been depressing the quotations for real mining engineers who are expected to economically operate properties for the wages of a drill-runner.

Possibly reputable engineers have seen the worst. They may be a "lock-up," as inactive stocks are classified; but the parsimony of principals and cupidity of those who trade on credulity, knowing "there is a new one born every second," has had enough attendant losses of late to bring about changes of policy. Once a "boob" always a "boob," need not be so universally. Otherwise, watching the tape for quotations on M.E.'s will be confined to ticker service in lunatic asylums.

With mining industrialism expanding—and the tape running behind—Canada is in open competition with the principals in the Boston episode. It would standardize the profession of engineering. There is a rising market for the competent, but that has not perceptibly affected the supply of the too-willing witness variety. On the contrary, Canada can export certain kinds of specialists. This is admonitory, as applied to possible importations, there being no domestic shortage.

Obliquity is not a matter of locality. Humans are apt to err, regardless of longitude, latitude, or altitude. Canada simply seeks a closed season for the pseudo—at least until the government at Ottawa refrains from offering employment to M.E.'s and Ph.D.'s—at salaries infinitely less than that referred to by "The Guilty One." By imposing an embargo upon fatuously frugal directors and indifferent speculators, it is sought to create an atmosphere in which the true scientist may exist, instead of being necessitously suppliant.

"I'll give you a report for $200, and put silver in the claim for $250," volunteered an incorrigible "engineer," when Cobalt was in its prime and brokers were playing to standing-room audiences.

He got the $250 and did not have to examine the property. Preferring "consulting work" to more strenuous employment, he was in greater demand among "business and mining men" of the Boston type than the soundly circumspect. Cobalt experience was costly. One "engineer" was feeding $3 rock to his mill at Porcupine while his shares were being pushed at a premium. The most complicated section at Porcupine was placed in charge of a "mucker." Who did it? A conscientious Cobalt superintendent, who has since developed engineering capacity and persuaded his principal not to sell his valuable ground for $200,000. He started

the chief owner on the highway to becoming a millionaire. For his foresight, he was rewarded at Christmas with an honorarium of $5.

"Oh," said the superintendent with unbecoming modesty, "I never expected anything of that sort. I'm perfectly satisfied with my salary." And his salary never was more than $1,800 a year!

Neither ethics nor blue-sky codes can govern where the human factor is lacking. Inevitably the functions of mining scientists are variable—largely made to order or of necessity. Fortunately, not every principal or combination has the viewpoint of the Boston syndicate. Discriminating capital regards mining enterprise as legitimately speculative, but declines to invite unnecessary risks. In this connection, ex-Governor Mackintosh, a veteran of the Canadian Northwest mining movement, points a moral. He had an old crony—a prospector—always optimistic, but never a non-resident of Poverty Gulch. The sourdough went to the Governor with a wonderful find—almost indescribably so. Fabulous was the word. "It's a basin of gold—the biggest thing ever"—urged the prospector. "You can have it for $750,000—because you're my friend; and I must have the money in a hurry."

Very gravely the Governor replied: "That sounds good. I'll have D. J. Macdonald take a look at it."

"I don't like to have Macdonald make the examination," parried the knight of the pan. "He'd condemn the mint."

Macdonald was commissioned and returned with the not unexpected report that the "basin" was "bunk."

When the pioneer came along, he never referred to Macdonald, but he tendered the property for $75,000.

The Governor was in a quizzical mood. With a severity of manner that was unusual he inquired: "Now, what is the lowest, bedrock price you'll take?"

"Seeing it's you," assented the prospector, "I'll let you have it for $75."

On general principles that sum was handed over, title was taken, and the prospector opened an account with a bank across the street, where he borrowed $100 on the strength of having "just closed a big deal."

The cheap engineer is expensive in the long run. At no time in the history of mining is there greater need of efficiency, and in due time those other than the fakers will find that out. ALEXANDER GREY.

Montreal, Canada.

The Premier Mine

THE EDITOR:

Sir—On page 610 of your issue of April 15, I observe an article upon the Premier mine which contains quite a little misinformation, and in the interests of accuracy I am making corrections as follows:

The option upon the property was taken by R. K. Neill in March, 1917, and the property thereafter developed by him and his associates. In the summer of 1919 I visited and examined the property in the interests of the American Smelting & Refining Co., along with other engineers of our organization and in conjunction with H. B. Price, engineer for Messrs. Keith and Untermyer, and shortly thereafter completed the purchase of a controlling interest for a group of four parties: American Smelting & Refining Co., Guggenheim Brothers, Minor C. Keith, and Isaac Untermyer.

Since then the mine has been extensively developed, and equipped with water power and with semi-Diesel engines as power auxiliaries in winter months; also with a mill of 100 tons' daily capacity and an aërial tramway of 11½ miles from the lower tunnel and mill direct to dock at Stewart, B. C.

A dividend of $400,000 was paid at the end of December, 1921, and $500,000 at the end of March, 1922, and if no particular publicity was given to either of these dividend payments, it was purely because there are only a few stockholders of the Premier, which is a Canadian corporation, and its shares are not publicly dealt in.

First-class shipping ore goes to the American Smelting & Refining Co. Tacoma smelter; second-class shipping ore to Granby smelter, Anyox, B. C., and lower grade to mill.

The management is lodged with the A. S. & R. Co., with myself as vice-president and managing director of the Premier. The plant manager is Dale L. Pitt.

New York City. H. A. GUESS.

The Hope for the Graphite Industry

THE EDITOR:

Sir—I do not know what interest Mr. Schmehl, who writes in your issue of April 8, represents, but assuming that he is a miner and producer, an impression which his article is intended to give, let us briefly analyze his figures.

Alabama graphite ore as mined averages about 2 per cent graphite in free form; selected Pennsylvania ore, about 5 per cent. This represents fifty tons of ore to the ton of graphite with a 100 per cent recovery in Alabama and twenty tons of ore to the ton of graphite in Pennsylvania.

His plant-cost estimate for Alabama is therefore $20 per ton of capacity and for Pennsylvania $50 per ton of capacity. The ore must be mined, crushed, ground, and milled. These figures speak for their author, not for themselves.

A cost of ½c. per lb. amounts to 20c. per ton for Alabama ore, and to 50c. per ton for Pennsylvania ore. This still includes mining, crushing, grinding, and milling, but no drying or finishing. Pennsylvania ore, to be of this grade, must be mined underground and selected.

Mr. Schmehl's article is printed on the wrong page. It should have been on page 562 under "One Is Born Every Minute." E. E. ELLIS,

Birmingham, Ala. President Celyon Co.

THE EDITOR:

Sir—I have read Harry A. Schmehl's article, "The Hope for the Graphite Industry," in your issue of April 8. Mr. Schmehl brings out some good points, but some of them are misleading.

He says, in regard to flotation of graphite, "One machine will produce from three-quarters of a ton to a ton of concentrates daily at a cost of about one-half a cent a pound." This is true, but this one-half a cent a pound represents not more than 20 per cent of the total cost.

Again, he says, "A 98 per cent extraction of the loose flake can be obtained." This is true, but represents not over 85 per cent economic recovery of the total carbon, under the most favorable conditions.

Again, he states, "The cost of a plant to produce five tons of 80 per cent concentrate daily would be less than $5,000, not including the land." Accepting his statement that from three-quarters of a ton to a ton of con-

centrate per day can be made from one flotation machine, then his five-ton plant would require from five to seven flotation machines. Standard flotation machines cost from $800 to $2,000 each—not including freight and cost of installation. The $5,000, then, would not even cover the cost of the flotation installation, much less the necessary mining equipment, primary breaker, grinder, drier and other apparatus. The Buhr stone system, including a bolting system that he mentions, would add additional expense for one finishing by that system.

Mr. Schmehl's article brings out his belief that a high tariff on graphite will be harmful; and that the low cost of production and the small capital required, together with efficient management, is enough to protect the graphite industry. Possibly! I would like to believe that graphite needs no protection, but the graphite tariff rates, as recommended by the Senate Finance Committee, are well in line with the needs of the industry and will not harm those graphite producers who are "honestly attempting to make a success of the venture."

Ashland, Ala. J. C. BARTON.

THE EDITOR:

Sir—In your issue of April 8 under the heading of "The Hope for the Graphite Industry" your correspondent, Harry A. Schmehl, advocates that instead of depending upon a tariff graphite miners in the United States should get down to hard work and make it possible to compete with the imported product. This may or may not be good advice, as it is possible that some properties could never compete with the best grade of graphite no matter how much work and time was devoted to them.

As one who has had some experience with graphite I realize that general statements of the comparison of graphite from different countries or districts are likely to be misleading. Some graphite ores lend themselves to economical and comparatively easy treatment and others do not, and the character as well as the grade of each ore must be carefully considered before a reliable statement can be made regarding the relative value of certain deposits, the recovery, including percentage of flake, that can be extracted, and the cost of production per pound.

The impression one might form from reading Mr. Schmehl's letter is that the profitable mining of graphite is a simple matter, as he states that the cost of a plant to produce five tons of concentrate daily amounts to less than $5,000, not including the land, and that one machine (flotation) will produce about one ton of concentrate daily at a cost of one-half cent a pound.

I am glad he does not include the land in the $5,000, but nevertheless his figures differ so widely from any that I have that I think some explanation from him might make them clearer to the average reader. Your publication is read by many, and it would be unfortunate if any likely investor gained the impression that refining graphite generally was a simple matter requiring little capital and plant, although it is possible that in certain districts conditions may be exceptionally favorable.

Too much money has already been wasted in the graphite industry on both sides of the line, and the records of the last thirty years are not much assistance in establishing what ultimately should be a thriving industry on this continent. H. H. CLAUDET.

Ottawa, Canada.

Russian Placer Mining

THE EDITOR:

Sir—In the *Mining and Scientific Press* of March 18, 1922, there was published a letter from L. A. Perret, referring to one that I wrote several months previously to the same journal. Mr. Perret states that I had therein ventured to prove the superiority of electricty as a driving power for dredges. This is far indeed from the case, for I would not advocate under every circumstance electrical driving for a single dredge. My letter was written merely to correct some gross misstatements concerning the Orsk Goldfields dredges, which Mr. Perret had used to support his contentions in a controversy with others.

It is quite evident that Mr. Perret's knowledge of the Orsk dredges is obtained from distorted gossip. Having been convicted of one serious blunder, he comes at it again. He now suggests that the steam dredge was fitted with a boiler that had previously been used on a stacker-scow, and was entirely inadequate for the purpose of the steam dredge. Mr. Perret in this suggestion is again entirely wrong.

Having previously confined myself to the correction of mistakes by Mr. Perret, I will now contribute briefly my own opinions: (1) The two Orsk dredges are so different, and work under such different conditions, that no satisfactory conclusions can be reached from their performance as to whether steam of electric driving is best. (2) Considering that the power station is fifteen miles distant from the electrically driven dredge, and as there was only one electric dredge, I think it would have proved cheaper had it been constructed for steam drive.

I trust that Mr. Perret will now see that my intervention in the controversy was solely to correct misstatements that had been made by him, and were likely to mislead your readers. S. J. SPEAK.

London, England.

Dean Probert's Protest

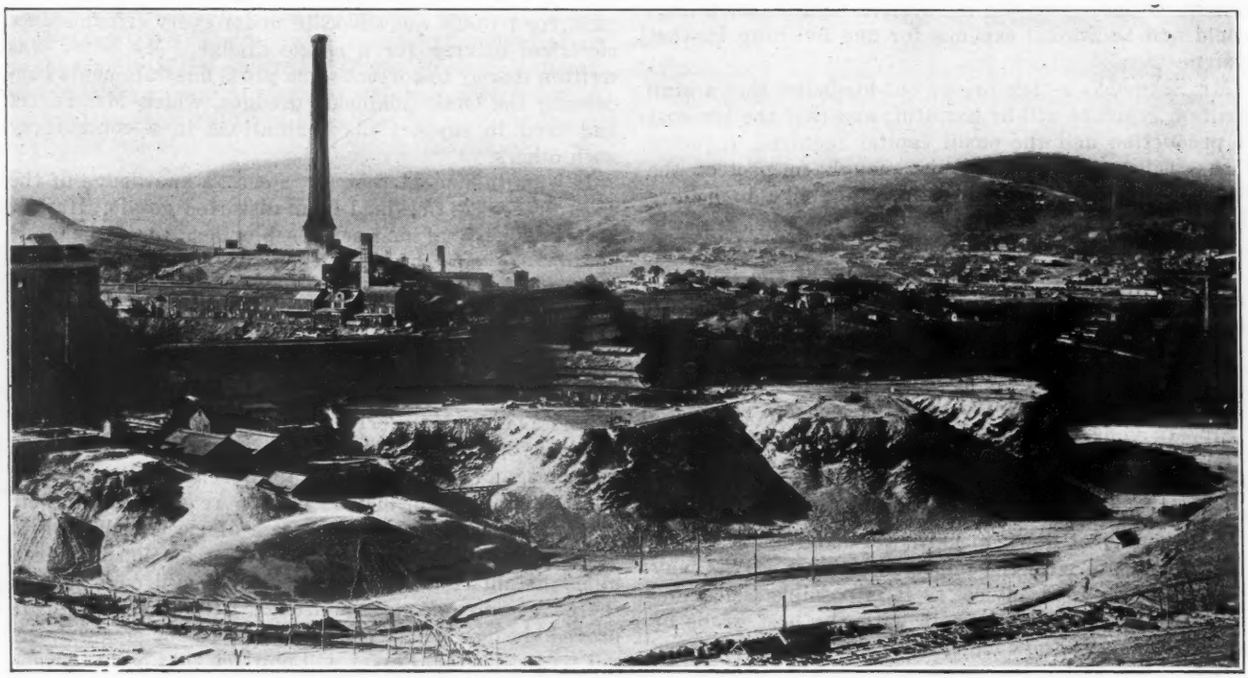
THE EDITOR:

Sir—I wish to second Dean Probert's spirited protest against the false impressions given by Mr. Young's articles on mining-engineering education. While Mr. Young's article showed a certain reportorial ability and an undoubted perseverance in his visiting so many mining colleges and filling so many pages in the *Journal*, they failed in many respects to present a true or even recognizable picture of the institutions they professed to describe. As Dean Probert stated, the articles could not be compared to the findings on mining engineering education recently published by the Mining and Metallurgical Society. Possibly Mr. Young lacks the philosophical background that characterizes the discussions of the Society. At any rate I think that Dean Probert was warranted in rising up and registering a protest.

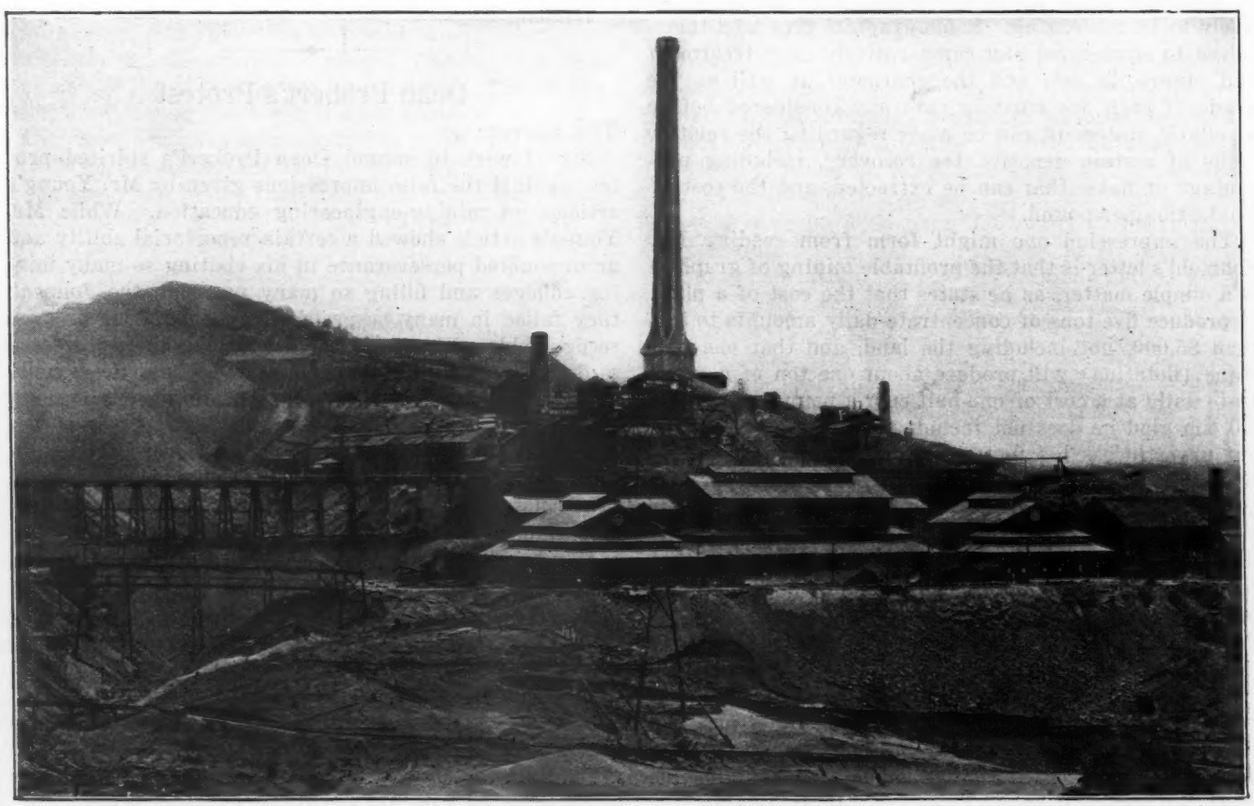
If you will permit me to proceed to another subject, I should like to express appreciation of the suggestion made by J. R. Finlay in your issue of April 8 to the effect that the *Journal-Press* should not confine itself to topics pertaining directly to mining. Certainly its readers, representing what Mr. Rickard calls the "class" of class journalism, have other class interests besides mining. That is, they have many predilections and sympathies in common, and like to see the lump of technique leavened with arguments of human interest.

New York. P. B. MCDONALD.

Views of Mount Morgan, Queensland

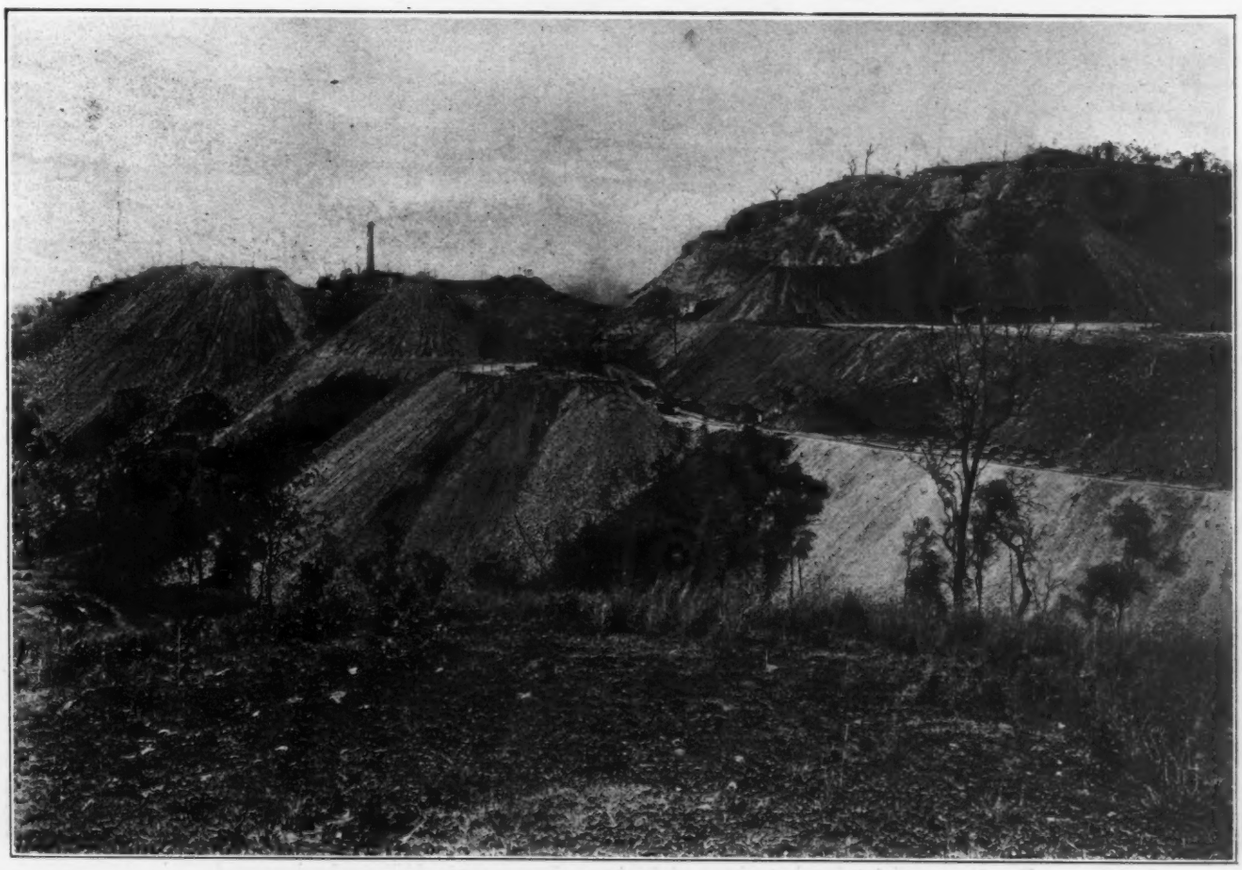


Copper reduction works of Mount Morgan Gold Mining Co., Queensland, Australia, which has resumed operations under a government subsidy



A nearer view of Mount Morgan's copper smelter

Mount Morgan mine and works in 1884



Mount Morgan's open cut and dumps, looking south

Heap Leaching of Low-Grade Copper Ores—I

Success of This Process at Rio Tinto in Spain Led to Trials in the Bisbee District—Over 70 Per Cent of Copper Extracted from an Ore Containing 27 Lb. Per Ton—A Large Part Lost by Floods and Seepage—Further Large-Scale Work Planned

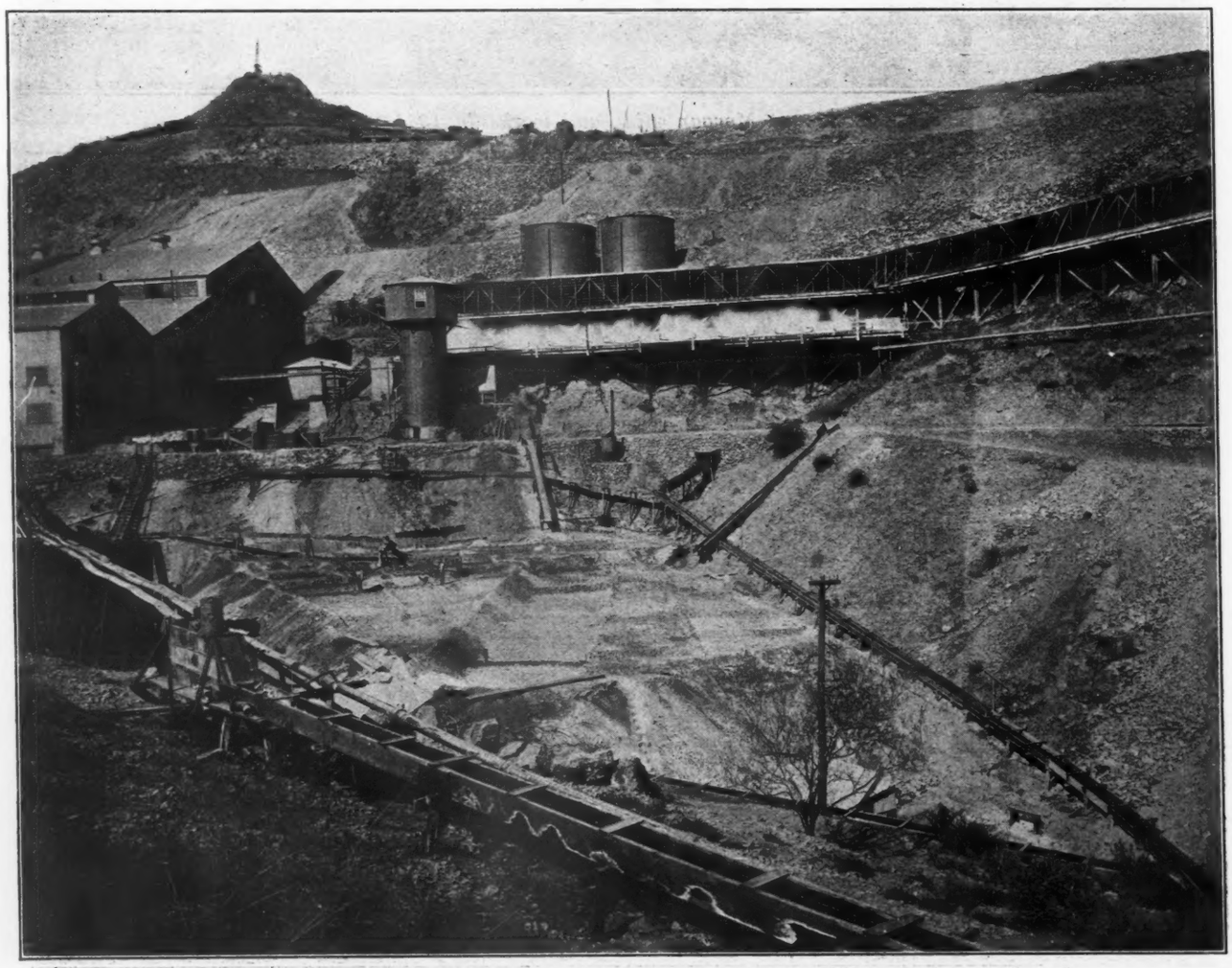
By Joseph Irving

HEAP LEACHING of low-grade copper ores is economical in a double sense; not only is the cost of treatment and recovery extremely low, but the method is applicable to those ores that are too low in copper for ordinary smelting or milling, as well as to those for which smelting or milling is too costly to be practicable, owing to their chemical and physical characteristics. One outstanding feature of heap leaching is that, with some simple modifications, all classes of copper ores are amenable. These include ores that contain the copper as oxide or carbonate, ores that contain the copper as sulphate, and ores that contain the copper as a sulphide. Those in the last class include dense sulphides, as well as schistose and siliceous ores such as the porphyries, which may contain a relatively small amount of sulphide.

Although it is admitted that cement copper was produced from mine water at Schmollnitz, Hungary, during the fifteenth century, the first authenticated record of the recovery of copper by heap leaching refers to practice at Rio Tinto in 1752. The heaps had been weathering for years, and had undergone a natural decomposition by atmospheric influences; the copper was leached by water and was precipitated on iron. At that time the process met with strong opposition from the general superintendent of the Hacienda Real, Pedro de Lerina, who stated that the cement copper obtained was nothing more than iron coated with copper, and that this falsification would do a great deal of harm to the Spanish copper trade. After a series of experiments by chemists at Madrid it was shown that he had made a mistake, but it was a long time before the lixiviation process was looked upon with favor.[1]

The wonderful success of heap leaching, or, as it is sometimes called, natural cementation, as evidenced by

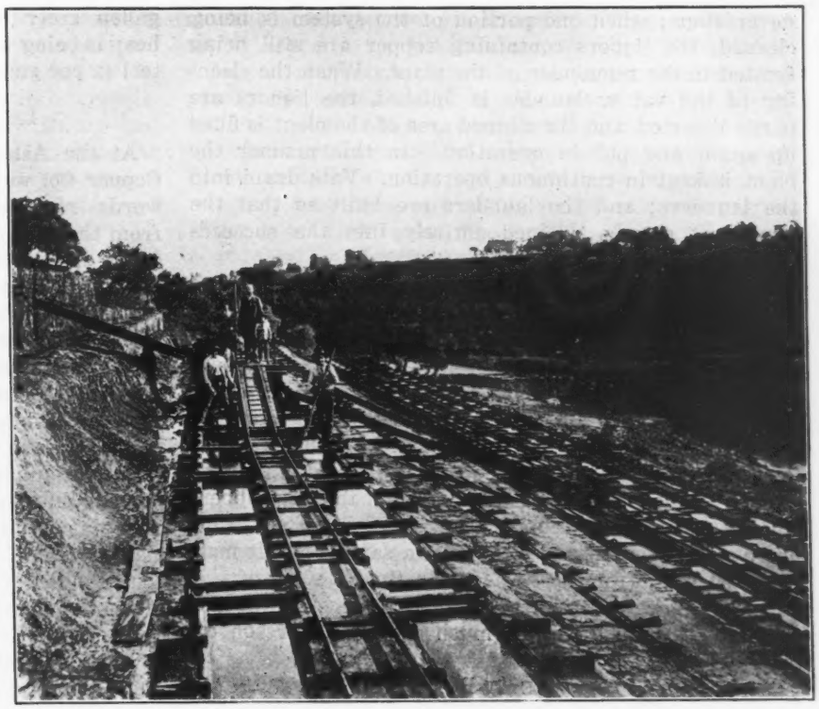
[1]Eissler's "Hydro-Metallurgy of Copper."



Ten-thousand-ton leaching heap at Bisbee. Sacramento Hill in background

the results obtained at Rio Tinto, Tharsis, Aznalcollar, and other mines in Spain and Portugal, as well as at the Wallaroo and Moonta mines of South Australia, leads one to consider the possibilities in applying such a method to the millions of tons of low-grade ore already mined and on dumps as waste in the southwestern states. One would think that a method for recovering copper that was so simple in its fundamentals would have appealed to many who had large quantities of low-grade ores on hand and for which there was no available market. In fact, the simplicity of the process is its best recommendation, as efficiency and simplicity are often synonymous.

My own experience with heap leaching started in Spain, where for several years I was cementation superintendent for the Seville Sulphur & Copper Co., besides having various opportunities to follow the work at Rio Tinto, at Tharsis, and at other mines in the south of Spain. The following is a general outline of Spanish practice:



Precipitation canals in Spain

A suitable site having an easy slope for drainage is first selected. The floor for receiving the ore is prepared and hardened; to assist oxidation and drainage, culverts 2 ft. high and 12 to 18 in. wide are laid long-ways, with intervening cross-culverts, so that all drainage from the heaps will run in one direction toward a common settling tank. These culverts are made from large pieces of poor ore that have been laid aside for cementation and thus serve a double purpose. Formerly, chimneys were arranged at various cross-section points of the culverts, so that a current of air could be maintained through the heap, thereby assisting sulphatization.

The ore which is to be treated, averaging 2 per cent copper, is now brought to the site, the larger pieces being laid first to a height of 2 ft. The remainder of the ore is then piled on this prepared base; it should contain about 10 per cent of 8-in. material and 50 per cent of 1-in. material, the rest being the usual run of fine. The heaps may be carried to a height of even 30 ft. The surface has a slight dip of 1 in 300, and is divided into shallow basins about 20 ft. square and 1 ft. deep. The water coming from the mine or from a reservoir is mixed with a proportion of the waste or tail-end liquor (with certain classes of ore the use of tail-end liquor is of immense advantage), and is distributed cautiously over one part of the heap for some weeks, a small proportion only of the copper being recovered thus.

The water is then diverted to another section of the heap, so that the partly treated ore may have a chance to heat and oxidize. The heat developed at this stage is not allowed to exceed 140 deg. F. When the temperature approaches this point the flues are closed to stop the draft, and the heat disseminates through the heap. When the partly treated portion of the heap is washed again, most of the copper present will be dissolved. The divisions on the surface of the heap are then leveled, and the positions of the shallow squares are shifted so that fresh areas of the heap are exposed for treatment.

The resultant copper-bearing liquors from this operation are led by a main channel through a filter bed of clean pyrite "smalls," placed in a suitable concrete vat (to reduce the excess of ferric salts), and thence to a common settling tank. The copper liquors are finally run through a series of vats, canals, or launders containing iron, which precipitates the copper in metallic form. This copper precipitate is known as cement copper. The iron goes into solution as ferrous sulphate. In the recovery of the copper it is customary to use vats at the upper end of the system, where the copper liquors are richest. Concrete vats with a cement facing were formerly used, but now frequently they are lined with wood. We found by experience that wood-lined vats are the best and cleanest with which to work; they last longer than do bare concrete vats. These are 20 ft. long by 10 ft. wide by 3 ft. deep. The floor has a slight slope to the lower end. They are generally filled for three-quarters of their length and for all their width with pig iron, laid on timbers 6 in. above the floor and piled in castle form. Some scrap iron is laid on top. The copper liquor passes through these vats in a steady flow, being diverted at the entrance so as to fall to the bottom of the vat and rise through the stacked iron to the overflow, care being taken to keep the iron always covered in the copper-bearing liquid.

From the vats, the liquor passes through a series of wooden canals or launders, 3 ft. by 1 ft. in section, which have an inclination varying from 1 to 200 in the first set to 1 in 50 in the last sets. These launders are arranged in sets of at least two, the liquor passing through them and running off at last with only a trace of copper. It is good practice to have a trace of copper in the tail liquor; it shows that iron is not being consumed unnecessarily.

The slope at the lower end of the plant also prevents an unnecessary consumption of iron. These vats and launders are arranged in series, so that precipitation

never stops; when one portion of the system is being cleaned, the liquors containing copper are still being treated in the remainder of the plant. When the cleaning of the vat or launder is finished, the liquors are partly diverted, and the cleaned area of the plant is filled up again and put in operation. In this manner the plant is kept in continuous operation. Vats drain into the launders; and the launders are built so that the upper set can be drained entirely into the succeeding set.

Liquors are sampled automatically, and flows are checked at the head and tail of the plant, and also wherever a fresh stream is introduced at an intermediate point. The launders are made of 3-in. pine, held together by dowel pins. Each side is painted carefully with hot pitch, and all seams are calked with oakum and pitch. The consumption of iron can be reduced to as low as 1.15 parts to 1 of copper. With ordinary care it need not go above 1.25 parts of iron to 1 of copper. One meter of canal (launder) holds 573 lb. of pig iron, and a cleaner can attend to 30 m., or, say, 95 ft. It may be noted that, from these heaps in Spain, some of the silver is recovered with the copper. I have known the first launders to return as much as 48 oz. per ton of precipitate.

Procedure at Rio Tinto

Heap roasting was practiced at one time at Rio Tinto. The heaps, or *teleras*, had a base of 20 by 26 ft. and a height of from 10 to 30 ft. Each contained from 800 to 1,200 tons of ore, and had one transverse and three longitudinal flues about 20 in. square, formed by the larger blocks of ore, communicating with vertical chimneys, of which there were two in the 800-ton heap and three in the 1,200-ton heap. Roasting might last for two months. Sometimes salt was added in the proportion of fourteen tons to the 800-ton heap, or about 1.75 per cent. In the Doetsch process, carried on for some time at Rio Tinto, the principal features were (1) the introduction of ferrous sulphate gathered from the Rio Tinto River bed, (2) mixing with salt in a roasting furnace, and (3) passing the fume over manganese dioxide, placed conveniently in the flue, thereby producing an excess of chlorine gas, which was led through towers and which met a descending shower of ferrous solution, forming ferric chloride. This process, together with the heap-roasting process, was abandoned many years ago, in favor of the simpler method of natural cementation.

For a long time it was contended that heap leaching as described is suitable only for heavy sulphide ores; but modern practice has shown that it can be applied successfully to ores in which the copper may be combined with small quantities of iron pyrite in a heavy schistose gangue, even in piles 30 ft. high. One essential requisite is to provide facilities for washing with tail liquors containing ferrous and ferric salts, as these help considerably in both washing and leaching. This is being successfully carried on at Rio Tinto and at Aznalcollar, near Seville, on ores containing from 1 to 2 per cent of copper. At Aznalcollar the heaps are from 5 to 6 m. high, say about 20 ft., and are washed with about 100 gal. of mine water per minute. This carries about five grains of copper per gallon. The mine water is augmented with 75 gal. of tail water per minute from the cementation plant.

The liquors from the heap enter the cementation plant with a copper content that varies from 15 to 20 g. per gallon, according to whether an old or new part of the heap is being washed; they leave the plant with from nil to 1 g. per gallon.

Leaching the Ore in the Mine

At the Aznalcollar mines of the Seville Sulphur & Copper Co. we also practised leaching *in situ;* in other words, river water mixed sometimes with tail water from the cementation plant was allowed to run into one of the mines, and the resulting copper-sulphate solution was pumped to the surface and passed through the cementation plant, where the copper was recovered. In leaching *in situ,* care must be taken to regulate the temperature, as too much cold water may develop a chill in the interior, and temporarily stop the leaching. On the other hand, the use of too much tail water will result in foul solution, which hinders recovery in the vats and launders unless the solution from the mine is passed through a pyritic filter before entering the cementation plant. The leaching *in situ* of waste material, gob, and old workings is practicable so long as it does not interfere with mining operations, but precipitation underground, other than under exceptional conditions, should be avoided.

Where a mine has a water supply that contains copper leached from various parts of the workings, and if it is provided with a drainage system that makes it independent of pumping, interior precipitation might be adopted with profit and safety, provided there is plenty of room and the ventilation is good. When, however, the mine drainage has to be pumped to the surface and discarded, precipitation underground should be avoided; it is not efficient.

Leaching in place was also practiced at the Cronebane and Ovoca mines, in County Wicklow, Ireland, about 1880. It is worthy of note that at the latter place the operators had a monorail system for distributing the iron, which was dropped into launders on each side of the rail. This may be a digression, but it seems an easy step from heap leaching to leaching in place; and to some it would appear better to get the copper from poor workings and so to save on the mining cost.

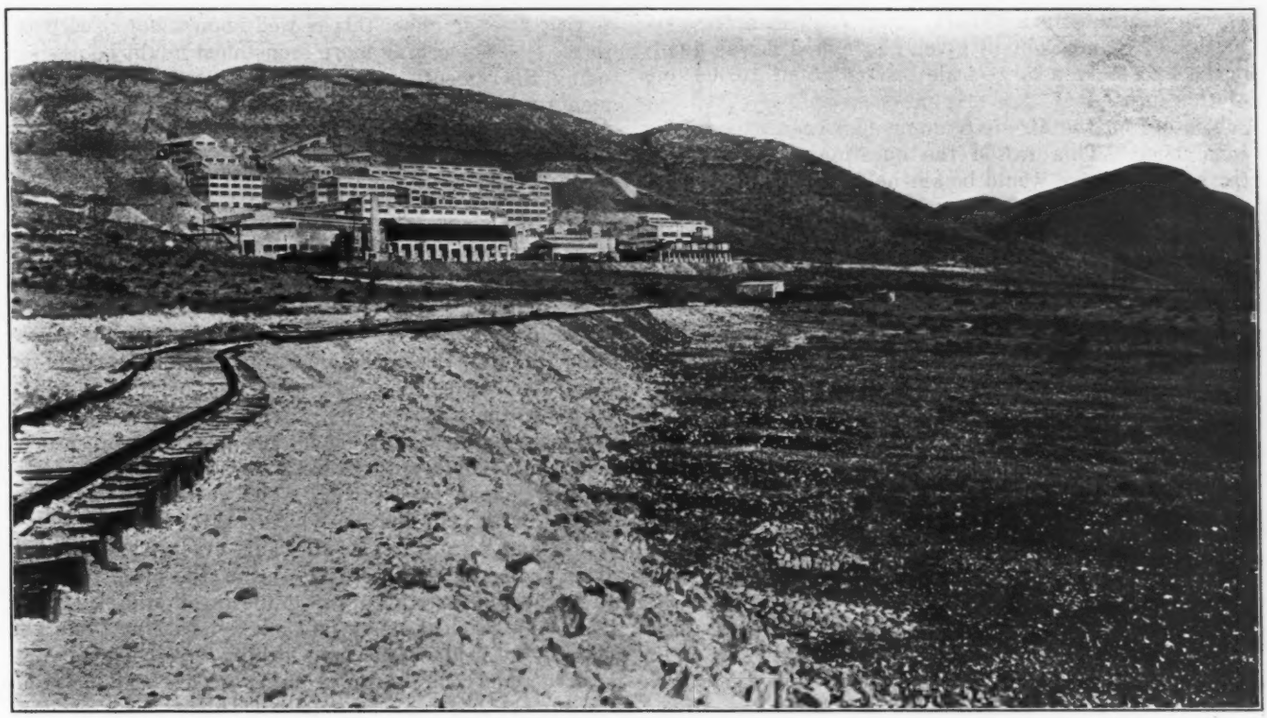
Australian Heap-Leaching Practice

For the last twenty years, the heap leaching of old coarse tailing has been carried on successfully at the Wallaroo and Moonta mines, in South Australia. The general scheme is similar to the Spanish practice, the old tailing being piled in heaps varying in height from 30 to 60 ft. and the surface being divided into 12-ft. squares, to control the distribution of the solutions. The leaching solutions, containing sulphate of iron and a little free sulphuric acid, are pumped to the surface of the heap by acid-proof Worthington compound duplex pumps. Cast-iron wood-lined pipes are used to convey the solutions, which consist of mine water and tail solutions, from the precipitating plant. These are supplemented by sea water pumped from Moonta Bay, which makes up for losses by evaporation and seepage. The copper-sulphate solution that percolates through the heap to the base is conducted by drains to earthenware pipes, and flows by gravity to the precipitating vats and canals, all the copper being precipitated on scrap iron. The tail water from this plant is returned to the heap.

About the same time that heap leaching was started at Wallaroo, I introduced it into Tasmania, and tested its possibilities on some heaps at Mount Lyell with moder-

ate success, recovering about fifty tons of high-grade copper precipitate. The work was still in operation when I left, although not viewed with much enthusiasm, as the ore was partly chalcopyrite and partly bornite, the latter being difficult to dissolve. The climatic conditions, with a rainfall of 140 in. per annum, were far from ideal for a method that requires a certain amount of atmospheric heat and dry weather to produce good results.

In view of the success attending the heap leaching of low-grade copper ores in Spain and Australia, it occurred to me that there was a field for this method in the Southwest, and that the same success could be duplicated in part, at least, on the great tonnage of low-grade siliceous ores that had been considered worthless. In 1914 I brought the subject to the attention of the Phelps Dodge Corporation—the pioneers in so many of the recent advances made in the copper industry—and explained to several officials the possibilities of this method for the treatment of the low-grade ores belonging to the company in Arizona and New Mexico. As a result, I performed a number of small-scale tests at Douglas and Bisbee, in Arizona, and at Tyrone, in New Mexico, from which it was evident that heap leaching had every chance of success with the low-grade siliceous ores of Bisbee and Burro Mountain. The ores of the Copper Queen mines at Bisbee were particularly amenable on account of their high sulphur and iron content, about 10 and 8 per cent, respectively.



Leaching heap of the Phelps Dodge Corporation, Copper Queen branch

Showing track for the delivery and distribution of ore, and arrangement of culverts in foreground. Ore bins for leaching and smelting ore in middle distance, with Copper Queen concentrator behind.

Work on Heap Leaching in Arizona

Laboratory tests at Douglas and Bisbee, on Sacramento ore crushed to 8 mesh, showed that in this fine condition the ore was readily amenable to a straight percolation treatment, using a mixture of ferrous and ferric solutions and no free acid. Most of the work done at Bisbee was on low-grade material from the Sacramento orebody, as that seemed to offer the greatest possibilities on account of the plan under consideration, of mining the hill by the open-cut method; this, it was expected, would release several million tons of extremely low-grade ore, probably running about 1 per cent copper. Contemporaneously, a test on Burro Mountain ore crushed to 10 mesh and assaying 2.05 per cent copper, using a solution containing 2 per cent iron (1.60 per cent ferrous and 0.40 per cent ferric), gave, by percolation only, an extraction of 50 per cent in fifty-eight days.

Another test on Burro Mountain ore was made at Tyrone, on a larger scale; it confirmed the probable value of this method when applied to the old waste dumps there. About ten tons of ore was placed in a vat provided with a false bottom to permit of free percolation. The ore was taken at random from the heap, large pieces being rejected, so that the charge had a chance to pack and settle, thereby making the percolation test more thorough. The ore in the vat was washed with mine liquor that contained no copper and with the following results:

Mine Liquor, Gallons	Percolation, Gallons Per Minute	Filtrate, Pounds per 1,000 Gallons	Surface Area, Square Feet	Total Depth, Feet
10,000	16	7.12	50	5

	Cu, Per Cent	SiO_2, Per Cent	Fe, Per Cent	Al_2O_3, Per Cent	S, Per Cent
Ore, head	2.44	69.37	5.50	14.62	3.44
Ore, tail	1.75	.....	....	.....	....

The results were an extraction of 28 per cent in less than a week.

Then it was resolved to test the Sacramento air-shaft dump, which had been weathering for years. Thirteen 100-lb. samples from this dump gave an average of: Cu, 1.3; SiO_2, 69; Fe, 11.2; Al_2O_3, 11.1, and S, 11.1 per cent. The rough rejects of these samples, crushed to

1 in., were used for tests, which were made on lots of 200 lb. each. All tests were made with tail liquor from the cementation plant used for recovering copper from mine waters. Details follow:

(1) Two hundred pounds of rejects, 1.05 per cent copper, treated by tail liquor from the cementation plant, showed in fifteen days, by assay of the liquor, an extraction of 1.03 lb. copper, equal to 49 per cent. Residue, 0.59 per cent copper, equal to 44 per cent extraction.

(2) Two hundred pounds of rejects, 1.35 per cent copper, treated in similar manner, showed in fifteen days, by liquor assays, a 36 per cent extraction; residue, 0.86 per cent copper, equal to a 36 per cent extraction. This ore being crushed to 1 in., a good extraction was possible in a comparatively short time. Further sampling of the Sacramento air-shaft dump confirmed the estimation of copper content given above, and it was finally decided to make a large-scale test on about 10,000 tons of this ore.

The ore on the air-shaft dump had been exposed for some time. This raised the question as to whether freshly mined ore would be amenable to this treatment. Accordingly, a series of tests on freshly mined Sacramento ore was made, which resulted as follows:

DETAILS ON LEACHING FRESHLY MINED SACRAMENTO ORE

Ninety-four One-Hundredths of 1 Per Cent Copper, Crushed to 1 In.; 200 Pounds. Straight Percolation. Treated With Tail-Liquor From Cementation Plant.

Extraction of copper in ten days, grains	647.55
Interval, nineteen days	
Extraction in thirteen days, grains	1,404.60
Total extraction in six weeks, grains	2,052.15
Equal to, per cent	15.5
Tailing assayed 0.85 per cent; extraction 14 per cent	
Interval, six weeks	
Extraction in ten days, grains	1,182.00
Previous extraction, grains	2,052.15
Total extraction in three months, grains	3,234.15
Equal to, per cent	24.7
Interval, six weeks	
Extraction in nineteen days, grains	2,700.12
Previous extraction	3,234.15
Total extraction in five months, grains	5,934.27
Total extraction in five months, pounds	0.847
Original contents of vat, pounds	1.88
Extraction, per cent	45

DETAILS ON LEACHING FRESHLY MINED SACRAMENTO ORE

Eighty-seven One-Hundredths of 1 Per Cent Copper; Crushed to ½ In.; 100 Pounds Treated With Tail Liquors From Cementation Plant.

Filtrate, Gallon	Copper Content Pounds per 1,000 Gallons	Actual Weight of Copper, Pounds
0.50	51.73	0.026
2.00	22.90	0.046
2.00	31.48	0.065
1.50	34.27	0.071
1.50	28.87	0.043
2.60	5.42	0.014
2.50	5.84	0.015
2.50	4.70	0.012
2.25	5.59	0.012
2.25	4.90	0.011

A total extraction of 0.347 lb. in twelve days equals 40 per cent.

DETAILS ON LEACHING FRESHLY MINED SACRAMENTO ORE

One-Half of 1 Per Cent Copper; Crushed to ½ In. Six Tests Carried on Side by Side. Straight Percolation, Using Tail Liquor From Cementation Plant.

	Total Gallons—To Ore	Total Gallons—From Ore	Copper Extracted—Lb. Per 100 Gallon	Copper Extracted—Pounds	Extraction—By Liquors Accumulated	Extraction—By Tailing Samples
1	40.0	36.75	3.35	0.123	67.5	70.0
2(a)	37.5	30.50	3.70	0.113	53.0	71.0
3	37.5	33.40	3.65	0.122	63.2	65.0
4	37.5	34.25	3.58	0.122	66.2	60.0
5	37.5	36.75	3.15	0.116	67.8	69.0
6	37.5	36.50	3.83	0.141	74.0	70.0

(a) No. 2 tank leaked badly and liquor results can be discounted.

Average extraction:	
By liquor samples, per cent	67.74
By tailing samples of leached ore, per cent	67.50

Special experiments demonstrated that if the liquor going on the heap was passed through a bed of sulphide ore (a pyritic filter), the leaching power of the solution was much increased, and the extraction of the copper was hastened. This is an item in a patent that has been applied for in connection with which several claims have been allowed. Some of the experimental results follow:

		Copper Per 1,000 Gallons, Lb.
A	Liquor to heap	0.27
B	Liquor from heap	1.30
A	Liquor to pyritic filter	0.27
B	Liquor from pyritic filter to heap	8.50
C	Liquor from heap	16.00

The last result is a decided improvement over the first, and proves that there is an advantage in using this method.

Use of High Ferric-Iron Liquors

It was expected that, as treatment progressed, there would be a gradual increase in ferric salts coming from the heap, which would mean an increase in the consumption of iron in the cementation plant. The value of the pyritic filter to offset this is well known, but it occurred to me that something more economical might be devised, using Sacramento ore; and accordingly some experiments with liquors heavy in ferric iron were made on freshly mined Sacramento ore, crushed to ½ in. and containing 0.94 per cent copper, with the following results:

	POUNDS PER 1,000 GALLONS Copper	Fe″	Fe‴	Acid
Liquor to Ore	3.55	0.20	31.80	38.50
Liquor from Ore 1	26.00	21.00	0.20	2.25
Liquor from Ore 2	24.00	25.00	1.25	2.20
Liquor from Ore 3	20.45	27.00	1.00	1.20
Liquor from Ore 4	21.25	27.00	2.65	2.40

The chosen site lay in the gully between the power plant and the Sacramento loading station; though not ideal, it was selected as being the most convenient. Owing to the nature of the ground, great care was taken in preparing this site; old lumber and slime were used to form a surface to prevent excessive losses of the copper liquors by seepage. The creek bed was also covered with cribbing, on which a layer of large pieces of ore and rock was placed. This creek was the main drain from the heap, serving also as the main inlet for air; other culverts or drains, nine in all and each 12 x 12 in. in the clear, were laid out, all passing from the edge of the heap to the main drain. The culverts were constructed from the large pieces of ore coming from the dump. The floor between the culverts was covered with large pieces of ore, to assist oxidation.

Details of the Test

The ore in the heap had in all probability been weathering from two to three years before it was moved to the site. This conclusion is deduced from the fact that the air shaft was sunk between May and August, 1912, and ore was still being dumped during 1915. There is no doubt that the heap was composed principally of the material dumped during 1913 and 1914.

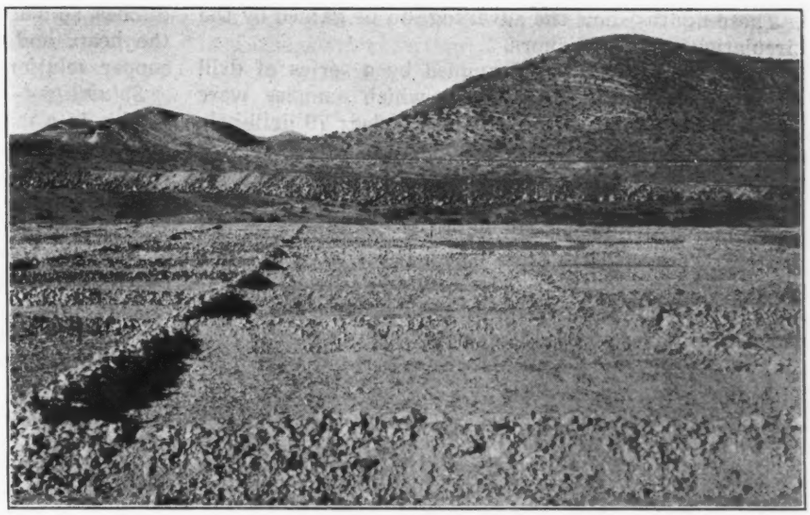
We began moving ore from the air-shaft dump in October, 1916; and with few interruptions this was maintained until Jan. 31, 1917, by which date we had on the heap:

Wet Tons	Moisture Per Cent	Dry Tons	Copper as CuO, Per Cent	Total Copper, Per Cent	Copper, Pounds
9,754	2.74	9,487	0.15	1.33	252,354

The amount of copper reported as CuO was obtained from mill records, which showed that about 2,200 tons was treated.

The ore was transported to the heap in 19-cu.ft. mine cars, the contents of each of which averaged 2,086 lb.; so that after allowing for moisture there was a little over one ton dry ore per car. At the start each carload

was weighed and tared. Later we weighed and tared 12 per cent of the total each day. A sample was taken from each car at the loading bins, and the whole daily sample was sent to the laboratory and assayed for copper only. Moisture samples were also taken daily. A composite sample was prepared at the end of each month, and run for general analysis, of which the following is a fair average: January, 1917: Ag, 0.12 oz.; Cu, 1.30 per cent; SO_2, 60.7 per cent; Fe, 10.5 per cent; CaO, 1.2 per cent; Al_2O_3, 12.1 per cent; S, 9.9 per cent. When complete, the heap had an average depth of nearly 20 ft., and a surface area of 12,000 sq.ft.



Surface of the Copper Queen leaching heap, ready for operations

Leaching was started on April 2, 1917, being continued without serious interruption until Nov. 2, 1917. Treatment for the first three months consisted of intermittent washing with water from the spray. After that period all washing was with tail liquor from the cementation plant, no free acid being used. At the beginning of operations the extraction of copper was high, ranging from 10 to 20 lb. per 1,000 gallons, for the heap had been weathering for about three years. During April and May the average extraction was 9.76 lb. per 1,000 gallons, or an average of 444.75 lb. copper per day. From June 1 to Nov. 2, the average extraction was 4.73 lb. per 1,000 gallons, or an average of 269.20 lb. Thus, each week we were recovering from 0.8 to 1.0 per cent of the original copper.

	Gallons To Heap	Gallons From Heap	Pounds Copper Per 1,000 Gallon	Pounds Copper Extracted
June 1 to Nov. 2	8,670,122	8,765,155	4.73	41,458

	Pounds Copper in Heap—April 2	Pounds Copper in Heap—Nov. 2	Pounds Copper Extracted	Extraction Per Cent
	252,354	184,211	68,143	27.00

	Total Gallons	Pounds Copper Per 1,000 Gallons	Pounds Copper Extracted	Operating Cost	Cost Per Pound of Copper Extracted
April 2 to Nov. 2	11,496,546	5.94	68,143	$2,301.54	3.36c.

	Pounds Extracted	Recovery At Cementation Per Cent	Recovery At Plant Pounds	Recovery Costs, Cents	Total Cost Per Pound On 90 Per Cent Recovery
	68,143	90	61,329	3.50	7.26c.

During the period of rest, November, 1917, the heap was sampled by a series of drill holes and pits, from which about fifty samples were taken at depths running from 3 to 18 ft. The result of this sampling showed that an average of 31.53 per cent of the copper originally in the heap had been dissolved. Copper extracted, according to liquor samples, was 27 per cent and copper extracted according to sampling of heap, 31.53 per cent. This difference may be accounted for partly by dissolved copper still in the heap, partly by loss as a result of seepage, and partly by loss as a result of floods. Leaching was resumed on Dec. 19, 1917, and maintained until March 24, 1918, thus completing one year's treatment.

SUMMARY FOR APRIL 2, 1917, TO MARCH 24, 1918

Total copper, 80,810 lb.
Cost per pound copper extracted, 4c.
Cost per pound on a 90 per cent recovery, 4.45c.
Recovery cost, 4.6c.
Total cost per pound, 9.05c.
Cost of piling heap, plant, etc., $8,479.54.
Total cost, $11,719.37.
Copper extracted, 80,810 lb.
Copper recovered, 72,729 lb.
Copper in heap on April 2, 1917, 252,354 lb.; on March 25, 1918, 171,544 lb.
Extraction, 32 per cent.

The heap was allowed to oxidize from April, 1918, to November, 1918, when leaching was resumed and continued until April, 1919:

	Copper, Pounds	Extraction, Per Cent	Accumulated Extraction, Per Cent
April, 1918, to April, 1919	21,486	8.52	40.60

From April, 1919, onward, leaching was intermittent, results being:

	Copper, Pounds	Extraction, Per Cent	Accumulated Extraction, Per Cent
April, 1919, to June 11, 1920	14,861	5.90	46.49

Total copper in heap:

April 2, 1917, Pounds	June, 1920, Pounds	Copper Extracted, Pounds	Extraction, Per Cent
252,854	135,197	117,657	46.5

According to the estimated amount (0.15 per cent) of CuO in the heap, there was present about 28,461 lb. of easily soluble copper; the results show that in addition to this, 88,696 lb. of copper was acted upon and extracted. Although there is no doubt that the long period of weathering to which the heap had been exposed made the copper more amenable to treatment, too much stress should not be placed on that particular feature, as proved by the results already recorded of experiments on freshly mined Sacramento ore. One feature noticeable during the second and third years of treatment was the steady increase in the amount of ferric salts, which ultimately assumed serious proportions, rising on occasions to as high as 40 lb. per 1,000 gallons of solution from the heap. This meant a decided increase in iron consumption in the cementation plant, as well as fouling of the precipitate produced. This probability had been foreseen and experiments had been made previously on strong ferric solutions. Owing to limitations of surface area we could not hope in this instance to duplicate the experimental work, but we were able to circulate and return at various times a part of those solutions high in ferric salts, and with decided advantage as shown herewith:

1919		Pounds Copper Recovered Per Day	For Period, Days	
May 24-31 straight leach only		89.50	716	8
June 1-8 straight leach plus 33 per cent returned liquors		123.00	984	8
June 9-13	Do.	115.00	575	5
July 6-13	Do.	143.00	1,144	8
July 14-20	Do.	146.00	1,022	7
July 21-31 straight leach only		76.50	689	9

These figures show the advantage to be gained by the circulation of leach liquors.

The heap was carefully sampled by a series of drill holes placed 20 ft. apart, from which samples were taken of each 3 ft. as the drill descended; 79 drill-hole samples were obtained. A pit 8 ft. in diameter was sunk near the center of the heap to a depth of 6 ft. Samples were taken on the north, south, east, and west sides, and a drill hole was sunk in the center of the pit to a depth of 9 ft., from which three more samples were taken.

By reason of a steam-shovel cut through the south end of the heap, seven 12-in. cuts were made at 10-ft. intervals, each sample representing 3 ft. of each cut, with the following results:

COPPER, PER CENT						
1	2	3	4	5	6	7
0.31	0.38	0.30	0.40	0.47	0.70	0.26
0.61	0.45	0.43	0.42	0.68	0.29	0.22
0.15	0.58	0.45	0.48	0.50	0.26	0.22
....	0.35	0.20	0.22	0.35	0.35	0.26
....	0.44	....	0.70	0.41	0.21	....
....	0.40	....	....	....	....	....

One carload of ore was removed by steam shovel and dumped on a platform, then mixed and piled evenly; three separate cuts were sampled, and assayed 0.22 per cent, 0.34 per cent, and 0.55 per cent copper, or an average of 0.37 per cent.

The following figures show averages and losses: Drill-holes (79), 0.37 per cent copper; pit samples (11), 0.31; faces exposed by steam shovels (32), 0.39; carloads removed by steam shovel (3), 0.37; general average, 0.36; average extraction according to samples, 72.93; average extraction according to daily liquor samples, 46.49; difference, 36.25 per cent. This great difference can only be accounted for by seepage and floods. A trench 1 x 1 x 10 ft., dug at the base of the face exposed by the steam-shovel cut, showed 0.85 per cent copper. Assuming that this seepage was general under the heap, it is evident that an area of 20,000 sq.ft. or, say, 1,000 tons of soil, was impregnated so that it contained 0.85 per cent copper, which denotes a loss of 17,000 lb. of copper. The following summary shows the losses:

COPPER IN HEAP, 252,354 POUNDS

	Copper, Per Cent	Extraction, Pounds
By tailing samples	72.93	184,041
By daily liquor samples	46.49	117,157
Difference		66,884
Assumed loss by leakage, pounds		17,000
Presumed loss by floods, pounds		49,884

The dump was badly situated; it caught all the drainage of that side of Sacramento Hill from the power plant up to the old machine shop, the waters from the Gardner side, as well as the water discharged from the power plant. We put in safety launders to catch ordinary drainage and leakage from these points, but could not cope with heavy floods. The total may seem to represent a large amount of copper carried away by floods, but the Rio Tinto company has been known to lose, in a single night of storm, copper valued at several thousand pounds sterling from the same cause.

Important Aspects of the Test Work

Protection of Heap.—In view of the heavy losses incurred during treatment of the 10,000-ton heap, it is evident that a good layer of slime should be placed on the floor of the site, for a minimum depth of 6 in. This would obviate all losses from seepage. As to losses by floods, the heap must be protected by storm ditches, so placed that all flood-water will be carried past the heap, and away from the settler or reservoir for copper solutions.

Solubility.—It has been proved that the copper is soluble in a mixture of ferrous and ferric salts, such as may come from the mine or may be available as effluent from the cementation plant.

Penetration.—This was satisfactory, as shown by the fact that after seven months' treatment, pieces the size of an 8-in. cube taken from the 10,000-ton heap at a depth of 6 ft., and broken up, showed distinct evidence of oxidation throughout the mass, proving that the copper present in the heap, whether in fine or crushed ore or seemingly locked up in large pieces of rock, was all subject to the penetrating influence of the leaching solution.

Percolation.—This was all that could be desired; with an ore depth of 15 to 20 ft., the leaching solutions traveled from the surface through the heap and to the settling tank in 1.5 to 2 hours. This rate of percolation was maintained to the last. Of course we had the usual trouble due to the settling of basic iron salts, causing from time to time a temporary stoppage of percolation; this, however, was remedied easily by diverting the solutions for a few days and by shoveling off the mud when dry.

Saturation.—This was also good, as evidenced by the solutions seeping through the sides of the heap at a depth of 8 ft. from the surface.

From the foregoing it is evident that Sacramento mine ore can be safely piled to a height of 30 ft.; if delivered coarse enough it can be safely piled to 50 ft. Aside from the desirability of confining operations within a suitable area, there is a decided advantage in having a deep heap.

Ferric Salts.—Fouling with ferric salts is an important subject and deserves careful consideration. The accumulation increases steadily; in the third year it is likely to become a menace. The following figures showing the copper and iron salts in the liquor from the heap are instructive:

POUNDS PER 1,000 GALLONS

	Cu	Fe″	Fe‴
June 29, 1917	3.94	0.50	1.00
Nov. 1, 1917	4.81	6.33	7.33
Mar. 24, 1918	2.59	14.85	15.19
Nov. 1, 1918 (after six months' rest)	20.95	27.37	73.94
Nov. 5, 1918	9.84	22.53	26.28
Feb. 10, 1919	3.34	13.85	7.93
May 16, 1919 (after one month's rest)	3.07	7.00	17.40

Influence of Ferric Iron

During 1919-'20, the amount of ferric iron present varied from 15 to 20 lb. per 1,000 gallons of solution, and this in face of an ever-decreasing copper content. It is evident that if indiscriminate washing is maintained, a large amount of ferric iron in the solution from the heap will become noticeable during the second year, and it will continue to increase until it is out of proportion to the amount of copper coming from the heap. This increase in ferric salts will mean a corresponding increase in the consumption of iron in the cementation plant. This, in the third year, might amount to 5 lb. iron per pound of copper produced. With iron at 1c. per pound, this might be considered a high-water mark of inefficiency; it would certainly insure a cost of more than 6c. per pound of copper produced. The ferric iron comes from the heap or mine in the proportion of 3 of ferric to 1 of copper; it frequently goes as high as 7 to 1. In the third year, when the daily flow of solution from a heap might be ex-

pected to attain a volume of 1,500,000 gallons, the amount of ferric iron present may vary from 20 to 40 lb. per 1,000 gallons. Suppose we consider 30 lb.; this would mean 45,000 lb. of ferric iron per day, which in turn means a consumption of 22,500 lb. of iron, with no equivalent return in copper. In addition, 5,825 lb. of iron was consumed as equivalent for 6,553 lb. Thus:

$$\begin{aligned} 6{,}553 \text{ lb. copper} \times \tfrac{8}{9} &= 5{,}825 \text{ lb. iron} \\ 45{,}000 \text{ lb. ferric iron} \times \tfrac{1}{2} &= 22{,}500 \text{ lb. iron} \\ 28{,}325 \text{ lb. iron} &= 4.32 \text{ lb. iron per pound copper.} \end{aligned}$$

But 4.32 lb. of iron at 1c. per pound means an additional cost of 4.32c. per pound of copper. To this amount must be added a further slight consumption of iron, due to sulphuric acid in the solution, and also some mechanical losses. Actual experience in Spain has demonstrated that copper can be recovered with a consumption of 1.15 to 1.50 lb. iron to 1 lb. copper. This was proved in several periods of six months' duration. In Nevada, also, copper has been recovered with a consumption of 1.15 lb. of iron to 1 lb. of copper. If due precautions are observed at Bisbee, there is no reason why the results obtained in Spain and Nevada cannot be duplicated in any work now under consideration. The first necessary steps will be seriously to consider the proposed treatment of the heap, paying particular attention to washing, and to the proper control of the ferric iron.

Reduction of Ferric Salts

The aim should be to obtain the best product in the shortest time and at the least expense; to get the maximum amount of copper with the minimum volume of solution and as cheaply and quickly as possible. By circulating solution, or by pumping back the leach liquors from the heap to fresh ground, progress is made in the reduction of ferric salts which may be accumulating in liquors coming from portions of the heap under treatment. The return of these liquors is additionally desirable because of the increase in copper extracted per unit volume of solution; the high ferric salts are active in dissolving copper from the ore, the net result being an increase in copper extracted, with a low ferric iron content in liquor going to the cementation plant. Moreover, a powerful oxidizing agent goes to the heap, which ultimately means a quicker return. By returning liquors to the heap the efficiency may be increased up to 40 per cent, as has been demonstrated on Sacramento Hill ore.

Referring to the work done with solutions high in ferric salts, it must be borne in mind that here the returned liquor was delivered to ore that had been partly treated already, and was cold—two factors prejudicial to good results. The best results are obtained when the returned liquor can be delivered to fresh ore, or at least to dry ore.

By the proper circulation and distribution of solutions, it is possible to obtain an almost perfect liquor to send to the cementation plant. The maximum amount of copper is obtained with the minimum volume of solution, which is to be desired; for the plant should be designed to recover copper, rather than to treat immense volumes of solution that are low in copper. An increase in copper in the liquor means cement copper of higher grade, less iron consumed per pound of copper recovered, lower freight and a saving in smelting charges. Further improvements can be effected by the installation of reduction beds or filters. These filters may be made from ordinary sulphide ore (pyrite), or other reducing material.

Utilization of Heap Leaching on a Large Scale

The results obtained from the small pilot heap at Bisbee, and the general information derived therefrom, supplied the incentive for the large-scale operations now contemplated. Nearly 300,000 tons of ore, containing about 0.90 per cent copper, has been distributed, culverts and drains being carried on ahead of the heap and about 50 ft. in advance of the piling of the ore. A large proportion of the surface of the dump has also been laid out in 25-ft. squares in anticipation of leaching operations. This heap when complete will contain nearly 2,000,000 tons.

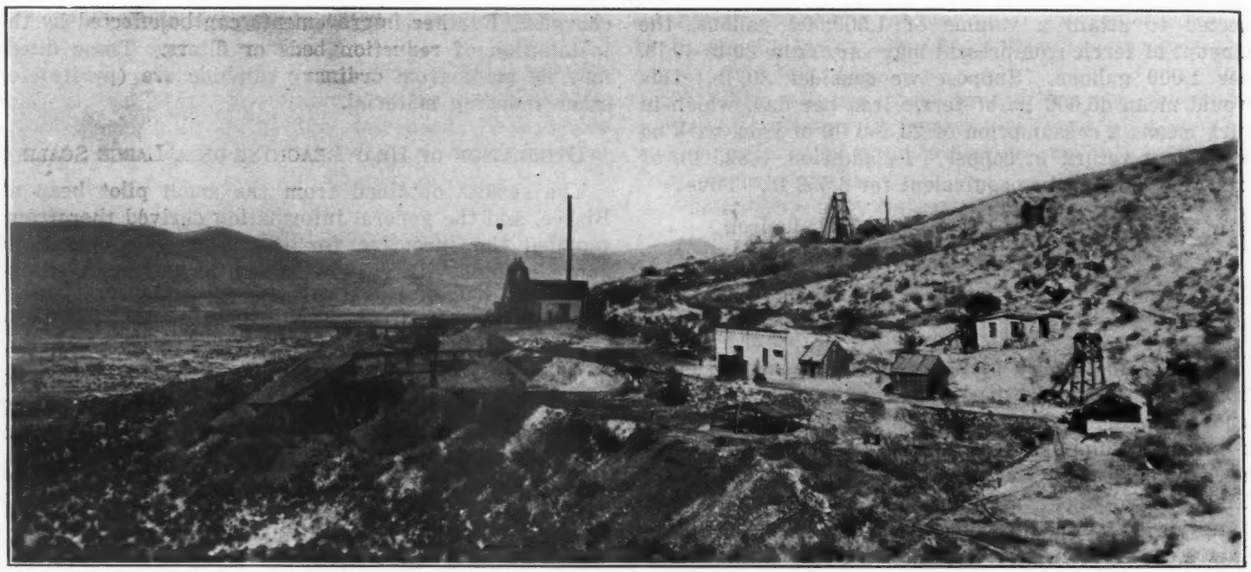
Efficient Heap Leaching Requires Care and Experience

Although the application of heap leaching to the treatment of ores is simple, a large amount of care is required in preparing the heap. There is no necessity for crushing, as run-of-mine ore can be used throughout; pieces of 12-in. diameter come in useful for flues or culverts and for covering the floor of the heap so as to assist in the proper dissemination of air. The site for the heap should be cleared of all brush, scrub, and heavy rocks. It is sometimes advisable to put a layer of slime or mill tailing over the ground to prevent excessive loss by seepage, but this is not always necessary. After the floor has been covered with large pieces of ore, culverts (having an opening of 12 in.) are built at distances of about 25 ft., according to the depth of the heap and the coarseness of the ore. These culverts are connected with other intersecting culverts, so that the floor of the heap is exposed to direct air currents and consequent oxidation. The culverts act also as drains to convey the solution toward the precipitation plant.

To insure good oxidation, one should take into consideration the nature and character of the ore to be treated and the proposed depth of the heap. Great care must be exercised in building the heap so that the proper proportion of coarse ore is mixed with fine material to insure good percolation. The operation of the heap also calls for skill and experience; it is not merely a case of running on water and getting out copper. Indiscriminate washing is the forerunner of trouble. Leaching solutions should be distributed carefully, so that washing and percolation are always under control.

The amount of copper in the solution coming from the heap is always a good indication as to the desirability of continuing work on the section under treatment, or of changing the flow. The deposition of basic iron salts must also be taken into consideration, for the settling of these on the surface of the heap, if not checked from time to time, will interfere seriously with leaching. Treatment of the heap will last from three to five years, depending on various conditions, chemical and mechanical; as a rule, however, profitable extraction should be complete within five years. In Spain, after five years' treatment, when the copper content of the heap has been reduced to about 0.25 per cent, the leached residue, containing about 48 per cent sulphur, is shipped to England to sulphuric-acid and alkali works.

To be concluded in the May 6 issue



San Jose mine, Sierra Mojada, Coahuila

The Constancia Mining Properties in Coahuila

A Lead-Silver District With a Good Record—Product Shipped to Custom Smelters—Costs of Operation

BY S. F. SHAW

THE PROPERTIES of the Constancia Mining Co. are situated in the Sierra Mojada district, Coahuila, Mexico, at the end of the Mexican Northern R.R. which extends from Escalon, Chihuahua, to Esmeralda, Coahuila, a distance of 125 km. Another railroad is now being extended by the government from Cuatro Cienegas to Sierra Mojada, and lacks about 40 km. of reaching the latter place. This new road will afford much better facilities for freighting coal from the Sabinas coal fields and for shipping ore to the Monterrey smelters.

The district was discovered in 1878, since which time the mines have been in continuous exploitation. The principal ore mined for many years was an oxidized argentiferous lead ore, containing approximately 500 g. of silver, 20 per cent to 30 per cent lead, with considerable excess of iron over silica, and highly prized by the smelters. For many years the ore was shipped to the United States, but after a high import duty was placed on lead by the United States, it became profitable to erect smelters in Mexico to treat the ore, and the result was the creation of an important industry in Mexico. In this connection it may be remarked that the duty about to be placed on zinc ores entering the United States will probably result in the establishment of zinc smelters in Mexico, perhaps close to the coal district, thus depriving United States smelters of Mexican zinc. In all likelihood in the course of time industries for the manufacture of zinc products will be started in Mexico, permitting successful competition with the products manufactured in the United States.

No exact data are available covering the production of ores from the Sierra Mojada district, but it is probable that in excess of 3,500,000 tons of lead ore and 2,000,000 tons of copper and silver-lime ore have been shipped, yielding $10 to $15, United States currency, per ton, or a total of $55,000,000 to $80,000,000. The production from the Constancia properties alone has been probably 20 per cent to 25 per cent of this total amount.

The principal mines owned by the Constancia company are the Deonea, Esmeralda, Guadalupe, and Providencia mines, and the Tiro I and Monterrey mines have been worked under lease. The Constancia company also owns considerable interest in the Fortuna, Fronteriza, San Salvador, and other mines.

The principal rocks to be found in the Sierra Mojada district are Cretaceous limestone and a volcanic extrusive termed "agglomerate" by Garrey. Both of these rocks are covered in the valley by conglomerate, or closely cemented wash, which has been eroded from the higher elevations. The valley of the Sierra Mojada district was once occupied by the flanks of an anticline, the axis of which extended in a general east-west direction. The valley was formed by the erosion of the limestone along this axis, followed by the outpouring of volcanic material, in which in many places the angular fragments of granite and pieces of limestone can be seen. This agglomerate filled the valley and rose to a considerable height along the sides of the limestone cliffs. Erosion reduced the agglomerate to the level where it is now found, and in time there accumulated a considerable depth of conglomerate above the agglomerate, which has attained a known depth in the valley up to 500 ft. Along the contact of the lower surface of the agglomerate with the limestone a movement or slide of the agglomerate has taken place toward the valley, producing just below the agglomerate a zone of sheared or broken-up limestone, which varies from one foot to fifty feet in thickness.

The mineral solutions have arisen along a series of three known east-west fracture zones, the argentiferous

lead ore having been deposited along two or three strata of limestone favorable for the reception of the solutions. These lead replacements form a bed or *manto* or *mantos*, covering a length from east to west up to 5 km. and varying in width from north to south from 100 to 175 m. The siliceous lead ore and the copper-silver ore were deposited within the sheared limestone or at its contact with the agglomerate, the sheared limestone having proved readily accessible to the solutions. Later, copper and silver dissolved by meteoric waters were precipitated at lower points in the sheared limestone and along minute fractures, thus forming the silver-lime impregnations, large tonnages of which have been mined.

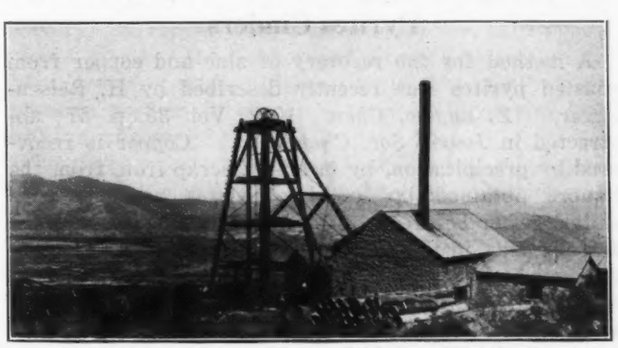
Local Smelting Abandoned

In the early days of the camp, when the argentiferous lead ore was the principal or only ore produced, the Constancia company operated a lead smelter and handled a considerable tonnage, as attested by the large slag dump on the property. With the building of the railroad and reduction of smelter tariffs, the resulting lowered grade of lead ore that could be shipped, and the mining of large quantities of limestone, it was found more profitable to ship the ore to the various custom smelting plants.

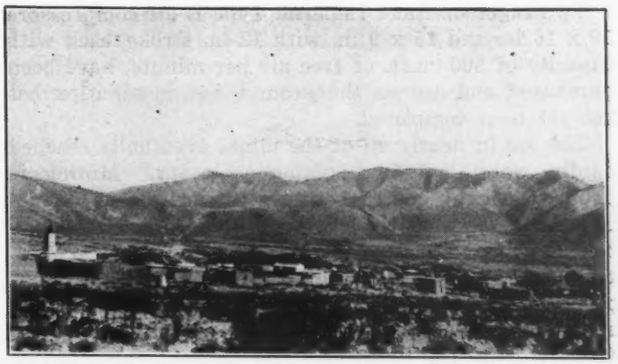
There was little need for prospecting in the lead *mantos*, as it was found to be fairly easy to follow the ore. Vast tonnages of this lead ore were packed on the backs of peons from the working faces to the main haulage levels, and in many workings to the surface. Little foresight was exercised in the early days in laying out levels so that the transportation of ore could be done economically.

The so-called contact orebodies were not continuous, as were the lead *mantos;* therefore a large amount of prospecting work was necessary in finding the ore. As the contact dips from almost horizontal in a few places to 45 deg. or more in others, prospecting inclines driven were not suitable afterward for transportation of ore in mine cars; therefore the packing of ore on the backs of peons continued. Occasionally the distance for this means of transport became too great, and the mines were obliged to utilize haulage levels. At first glance at the various maps of underground workings one immediately receives the impression of an abundance of haulageways, but is soon disillusioned by a trip through the mines.

A careful study of the maps and underground workings of all of the mines in the district has brought out the fact that although the contact orebodies and silver-lime impregnations are not continuous and are apparently erratic in their occurrence, they are, nevertheless,



Fronteriza mine, Sierra Mojada, Coahuila



Sierra Mojada, Coahuila

found along certain east-west channels, and a careful plotting of the strike of these channels and the intersection with the contact will determine within close limits the position of the extensions of these orebodies. A careful search has revealed east-west striking fractures, or series of fractures, extending from the contact down into the bedded limestone under the orebodies, which fractures appear to have been the feeders of the ore deposits. By laying out haulage levels with reference to these lines or channels, the cost of handling the ore is materially reduced.

Need for More Efficient Methods

Nearly all of the equipment for hoisting is of small capacity, and little thought has been given to economies in fuel and labor. The equipment at the operating mines of the Constancia company is as follows: The No. 11 shaft on the Deonea mine has a wood headframe 24½ ft. high, and Parker, Field & Mitchell 8 x 12-in. single-drum geared hoisting engine. The ore is hoisted in a 16-cu.ft. skip with ⅝-in. steel cable. Steam is generated in a Fraser and Chalmers locomotive-type boiler, which has no brick walls to produce radiation. At this shaft there are two zinc calcining furnaces, each with ten tons' capacity of crude ore in twenty-four hours.

The Zaragoza shaft of the Esmeralda mine is equipped with a Flory 8 x 12-in. single-drum, geared hoisting engine. The headframe is of wood, 23 ft. in height. The boiler is of the locomotive type.

The northeast shaft of the Esmeralda mine is equipped with an Ottumwa Iron Works 8 x 10-in. double-drum, geared hoisting engine and Fraser and Chalmers return-tubular boiler. The headframe is 34 ft. high. Ore is hoisted in a self-dumping skip of 18 cu.ft. capacity.

The headframe of the Buena Ventura shaft at the Guadalupe mine is 35 ft. high. This shaft is equipped with Flory 8 x 12-in. single-drum geared hoisting engine. Steam is generated in a Fraser and Chalmers boiler. The ore is hoisted in a 16-cu.ft. skip. The cable is one inch in diameter.

The Monterrey mine is equipped with 8 x 12-in. Fraser and Chalmers single-drum geared hoist using 1-in. steel cable. Steam is furnished by an Erie City locomotive-type boiler. The headframe is 30 ft. in height.

The Tiro I mine has an 8 x 12-in. single-drum geared hoisting engine using 1-in. steel rope. Steam is supplied from an Erie City locomotive-type boiler. The headframe is 30 ft. high. Ore is hoisted in a 16-cu.ft. skip.

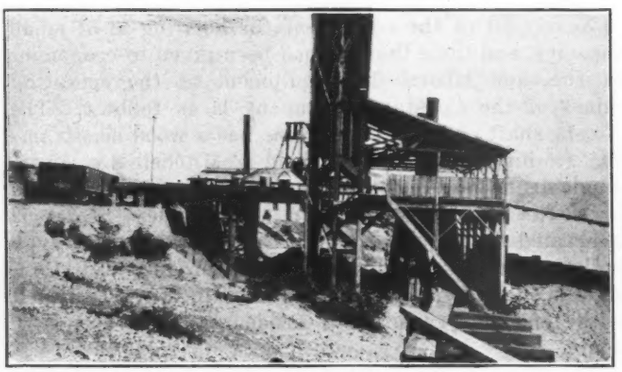
Two Ingersoll-Rand Imperial Type B air compressors 10 x 16 in. and 15 x 9 in. with 12-in. stroke, each with capacity of 500 cu.ft. of free air per minute, have been purchased and are on the ground, but installation has not yet been completed.

The ore in nearly all of the mines eventually reached depths where hoisting became necessary. Mining is usually done by contract at a given price per ton delivered to the shaft. It is then hoisted and trammed to the patio, from which it is wheeled in barrows, trammed in mine cars or packed on the backs of peons to the railroad cars. In some instances the arrangements are such that the ore can be shoveled directly from the patio into the railroad cars, and at one property a bin of 600 tons' capacity has recently been built alongside the railroad track, so that the ore can be loaded directly into the cars.

No attempt is made to reduce the ore in the district. During recent years, since the mining of zinc ore began, four calcining furnaces have been built in the district, and the oxidized zinc ores, containing approximately 30 per cent Zn, have been calcined to a zinc content of approximately 40 per cent, resulting in lowered freight costs and in a higher smelter return.

Costs of Operation

Considering the ease with which the ore can be mined, strength of walls, and dryness of the mines, the operating costs in the Sierra Mojada district have been rather high. The following costs, obtained at the Esmeralda mine on a small tonnage, will illustrate this point:



Parreña calcining plant, Sierra Mojada, Coahuila

OPERATING COSTS AT THE ESMERALDA MINE IN 1911

Distribution	Costs per Metric Ton Mexican Currency (Pesos)
Development contract	0.46
Stoping	3.28
Timber	0.77
Coal	0.05
Day's pay of men	0.58
General expense	2.24
Taxes	0.34
Transport	0.23
Total	7.95

OPERATING COSTS AT THE ESMERALDA MINE 1919-1920

Distribution	Costs per Metric Ton Mexican Currency (Pesos) 1919	1920
Development	0.62	2.74
Stoping	5.82	7.69
Maintenance of way	0.93	....
Hoisting	0.33	....
Transport	0.62	0.02
Repairs	....	1.46
General expense	3.98	7.57
Taxes	0.32	0.97
Total	12.62	20.45

The costs, especially those for 1919-1920, are excessively high, but with proper equipment, better discipline and better means for handling the ore from the stopes to the shaft, will be greatly reduced. It has been the observation of many engineers that cheap or so-called "pauper" labor does not necessarily make for low costs. This is well illustrated by the above costs and by the costs obtained in mining zinc ore from the Deonea mine during the year 1920, which were as follows:

COST FOR MINING ZINC ORE AT THE DEONEA MINE, 1920

Distribution	Cost per Metric Ton Mexican Currency (Pesos)
Development	2.24
Stoping	6.67
Maintenance of way	0.56
Transportation	0.22
General expense	5.68
Taxes	0.91
Total	16.28

The cost of calcining this ore was as follows:

Distribution	Cost per Metric Ton, Crude Ore, Mexican Currency (Pesos)
Labor	1.96
Fuel	2.12
Materials	0.12
Transport	0.61
Sampling and assaying	0.18
Total	4.99

The gross value of this ore per metric ton, f.o.b. El Paso, with zinc averaging 8¼c. per lb., in United States currency, was 48.68 pesos.

Shipping and other charges were as follows:

	Pesos per Metric Ton
Freight to the border	9.66
Border charges	1.80
Mexican export duty	1.30
Total	12.76

This leaves a net value of 35.92 pesos per metric ton of zinc calcines, or 27.66 pesos per metric ton of crude zinc ore, or 25.08 pesos per avoirdupois ton. With mining and calcining costs amounting to 21.27 pesos per metric ton, the profit was 6.39 pesos. Costs during 1920 were at their highest point, and with lower labor cost, cheaper supplies, and increased output the costs would be greatly reduced. Even under these bettered conditions this ore cannot be shipped to the United States at a profit when zinc is selling for less than 6c., United States currency, per lb. The heavy charges in transporting the ore from the mine to the smelter absorb too great a proportion of the total value to permit a profit to be made unless the selling price of zinc is unusually high.

Recovery of Copper and Zinc by Leaching Pyrites Cinders

A method for the recovery of zinc and copper from roasted pyrites was recently described by H. Reisenegger. (*Z. angew. Chem.*, 1922, Vol. 35, p. 57; abstracted in *Journ. Soc. Chem. Ind.*) Copper is recovered by precipitation, by means of scrap iron, from the liquors obtained by leaching pyrites residues with water, either before or after a chloridizing roast. The ferrous salts in the solution are then oxidized by chlorine gas and the iron is precipitated by addition of zinc oxide, with the production of an equivalent quantity of zinc salt. Addition of ammonia results in a precipitate of zinc hydroxide, and the ammonium salts in solution are recovered for use as fertilizers.

The Trade Association and the Mining Industries

Metal Producers Partly Organized—Copper Companies Are Members of Several Trade Associations Interested in Exports, Statistics and Publicity —Business Depression Stimulates the Formation of Industrial Associations

By Felix Edgar Wormser
Assistant Editor, *Engineering and Mining Journal-Press*

ONLY A CURSORY EXAMINATION is necessary to show that the mining industries of the United States are not well organized as far as the individual groups of metal or mineral producers are concerned. The two most important branches, coal and iron, have trade organizations, the National Coal Association and the American Iron and Steel Institute, but non-ferrous mining and the non-metallic mineral producers have but a few scattered group representations. Copper mining, the greatest non-ferrous metal-mining industry, has no organization of national scope to consider its particular problems, but is peculiarly interested in the activities of several associations, as will be shown. The zinc producers are an exception, with their well-organized American Zinc Institute. The lead producers in the United States have each steered an independent course. Silver and gold miners have organized only locally, though often effectively.

It is true that the American Mining Congress represents almost all the mining industries, as its membership is made up of coal, copper, gold, tungsten, and other metal and mineral producers, but its range is so broad that it cannot hope to cover the interests of each industry as effectively as could individual trade associations. The American Mining Congress is more a Chamber of Commerce of the mining industries than a trade association and is well fitted to cement the various producing units of the mining industries into one large organization that is prepared to represent them in matters affecting their welfare as a whole, such as taxation and Federal legislation.

Depression a Stimulus to Organization

When an industry finds itself in some unusual predicament, when it faces difficulties which threaten its prosperity and very existence, organization is comparatively easy. Adversity has accounted for many trade associations. Thus the Copper and Brass Research Association was formed to promote the wider use of copper and brass products and to discourage the use of substitutes —admirable objects, which the copper industry, finding itself enveloped in the worst depression in its history, felt were necessary to insure its prompt and substantial recovery. If copper were selling today for 1919 prices I doubt whether the Copper and Brass Research Association would exist. Necessity is the mother of invention no less in economic than in industrial and technical affairs.

It is perhaps incorrect to say that the copper industry is unorganized, as organization has taken a different direction from that in other mineral industries. Instead of one large association capable of discharging the duties common to the group, copper producers are interested in three trade associations, all performing separate and important functions—the Copper Export Association, the Copper and Brass Research Association, and the American Bureau of Metal Statistics.

The Copper Export Association was formed solely for the purpose of selling the copper production of its members collectively to foreign customers. It took advantage of the liberalization of the Sherman Law permitting combinations of producers or manufacturers to engage in export business. Peculiarly enough, the Copper Export Association actually stifles competition among its members for export trade, as no member sells copper to a foreign customer except through the association, and as each participates on a pro-rata basis in each sale of that body. What a furore would be caused by an organization engaged in similar activities in domestic trade! The Copper Export Association is permitted by law to do that in foreign trade for which associations would be prosecuted in domestic business transactions.

Producers Attempting to Popularize Use of Copper

The second trade association in which the copper industry is interested, the Copper and Brass Research Association, does not employ extensive laboratory facilities, as its name would indicate, but attends to the publicity problems of the copper and brass industries—advertising, if you will. It is an organization for commercial research into effective publicity methods which will be of value to the entire group. It is noticeable that the Anaconda Copper Mining Co. is running an attractive series of advertisements in the New York papers directing attention to the merits of copper shingles. The Anaconda Copper Mining Co. is specifically mentioned in each advertisement and seems to be responsible for the campaign. Being the most important factor in the copper and brass trade of the country, it is powerful enough financially to undertake an independent course and benefit thereby. Its position parallels that of the New Jersey Zinc Co. in the zinc trade, whose advertisements in its own behalf popularizing the use of zinc are generally familiar to the mining industries.

Collective advertising is one of the great fields open to the trade association and is only now beginning to be used. It enables both large and small producers to profit by an intelligent and concentrated effort to enlarge the market for their product. Although large metal producers occasionally are willing to finance an advertising campaign from which smaller producers derive an indirect and sometimes direct benefit, it would seem to be more equitable to have this task performed by a representative organization of the industry rather than by the individual producer.

The third association which the copper industry aids is the American Bureau of Metal Statistics, which furnishes to producers monthly statistics of production, consumption, and stocks, thus covering one of the functions of the ordinary trade association. It supplies valuable statistical information to copper pro-

ducers promptly and efficiently, but takes great precautions that its reports do not become public. For this policy the copper producers themselves are probably responsible, but it is hardly in line with Secretary Hoover's ideas in regard to trade statistics. However, no matter how carefully this information is guarded, it is usually well known by anyone who is interested in it within a short time after it is distributed.

Several Large Groups Control Copper Production

Through these three organizations, copper producers have been able to tackle separately three of their most important problems—export trade, the provision of promptly available statistics, and wider publicity. I know of no other metal industry so organized. However, they have no regular means of getting together for the discussion of matters not germane to activities of the three associations mentioned.

Copper producers in the United States or in the Western Hemisphere are organized into six large and financially powerful groups, with such a strong grip upon the world's production that perhaps they do not feel the need of further organization. Thus, the Hayden-Jackling-Guggenheim-Morgan group controls the Utah, Ray Consolidated, Nevada Consolidated, Chino, Chile, Braden, Kennecott, Butte & Superior, and American Smelting & Refining companies. Another, the Rockefeller-Ryan group, controls the Anaconda, Inspiration, North Butte, Utah Consolidated, and Mountain Copper companies. The Phelps Dodge, W. A. Clark, Calumet & Hecla, and Adolph Lewisohn interests are other important groups. Among all of them there is a certain amount of business rivalry and pride of organization. Each group usually has a definite sales policy for its product and is strong enough financially to carry out any of its business plans to further the welfare of its group. Nevertheless, they are all in the same boat when it comes to struggling against conditions that forced practically the entire industry to shut down. The last two years offered a splendid opportunity for the producers to organize an association that would represent them for years to come, but it has only been taken advantage of in the direction indicated above.

An American Copper Institute has much to recommend itself to the consideration of copper producers. For one thing it would give an opportunity for the members to know each other better and induce a more sympathetic attitude among them. The functions of the organizations having to do with statistics and publicity for the industry's products could be readily taken over by the new association and many others added to them. As for the Sherman Act, the present temper of the business administration in Washington and its desire to use the trade association in stabilizing business, with the strong probability that rules will be promulgated for their guidance, is an indication that the United States is emerging from a period of wastefulness to a period of intense but enlightened competition in which the trade association will play an important part. The legitimate trade association, playing with all its cards upon the table, never had anything to fear from the Sherman Act.

It may be difficult to convince some copper and other metal producers that the publication of statistical information will not jeopardize their own interest and that any fancied advantage they possess is largely illusory, but I have no doubt it will ultimately be done.

Zinc producers have a strong and well-organized trade association in the American Zinc Institute. It is one of the organizations formed as a direct outgrowth of the war conditions at the height of the conflict—July 29, 1918. No better example of the work of a trade association in the metal trades exists, and space will be devoted in another article to treat of its many accomplishments, trials, and tribulations. The zinc industry is now organized in a most thorough manner, and is adequately prepared to lend its influence upon any issue which affects the industry as a whole, be it the tariff, taxation, or transportation. Individual antagonism and the jealousy which were characteristic of some zinc producers before the war have given place to a much more wholesome spirit of "live and let live."

Lead Producers Unorganized

Individual rather than collective action has been the rule among lead producers on any issue affecting their interests. Unlike the situation in copper and zinc, no stimulus, such as overproduction or loss of markets, has encouraged the lead companies to form an association to improve their lot. The lead industry is not overbuilt; production and consumption generally strike a good balance and prices fluctuate slowly. Business has been steadier in lead than in any other non-ferrous metal during the period of deflation; and if business is good, why worry about a trade association? This seems to have been the reasoning. Another deterrent to organization is to be found in the charges that have been made against lead manufacturers' associations of maintaining prices and destroying competition.

A few lead companies in the United States control production. They are the American Smelting & Refining Co., the St. Joseph Lead Co., the U. S. Mining, Smelting, & Refining Co., the Bunker Hill & Sullivan Mining & Concentrating Co., the National Lead Co. and a few smaller producers such as the Eagle Picher, and the American Zinc, Lead & Smelting Co. Whenever any subject arises vital to their interest, individual action has been the rule. There is less reason to anticipate the formation of a lead institute than to expect the creation of any other non-ferrous metal organization. Statistics covering lead production, consumption, and stocks are gathered and distributed by the American Bureau of Metal Statistics. Fortunately for lead, the slogans "Make-it-of-lead" or "Buy-something-made-of-lead" have not had to be used in an effort to widen the market for the metal, with its excellently diversified market. Nevertheless, an unexpected predicament might conceivably suddenly involve the industry and encourage the formation of an organization to serve it. For that reason it would be well to be prepared.

Local Organizations Have Been Influential

Although many local state and district associations of gold and silver producers exist, they have no national organization. The local gold and silver producers' associations have done yeoman service in promoting or opposing issues influencing their prosperity. One of them was the first to agitate for a gold bonus, a cry that was picked up and almost carried to a successful conclusion by the American Mining Congress. Other local associations have busied themselves with technical discussions, to the mutual benefit of the members and have been a splendid agency to inculcate a warm feeling of co-operation among them.

Gold and silver producers are generally uninterested in the disposal of their product beyond the mint. They

have been content to let the banker concern himself with the use of the precious metal in commerce. During the war, the tremendous disorganization of prices and values presented an excellent opportunity for the study of the underlying causes of these changes, so that many a gold and silver producer is more familiar today with questions regarding exchange and premiums than he was before the war; but there is much room for further study of the gold and silver questions. The formation of an association of gold and silver producers —its title is secondary—would find a fertile field in the study of problems of the utmost importance to the restoration of sound currencies throughout the world. It could lend constructive assistance in introducing a sound metallic basis for the world's monetary systems and handle such a question as the establishment of an American silver exchange.

What will the silver producers do to meet the time, only two years hence, when the repurchase provisions of the Pittman Act will have been fulfilled? Surely that alone is a topic important enough to require the early attention of the entire silver-mining industry of the country. If the principal and minor silver producers believe the issue important enough to warrant the formation of an organization to consider their problems, they should be amply rewarded for the effort. In passing, were a silver association in existence today, would not it be an ideal means of combating the propaganda which occasionally appears seeking to repeal the Pittman Act? If no national association is formed the local bodies can continue their admirable work and they should receive support.

Trade Associations Can Accomplish Great Good in Non-Metallic Fields

When we come to the non-metallic industries, exclusive of coal, we find that those industries supplying building materials, sand, gravel, stone, and cement are fairly well organized, and in some trades too well organized, in that they have exceeded the functions of the legitimate trade association in attempting to maintain high prices, stifle competition, and indulge in other nefarious practices. Those associations have brought disfavor upon all associations, though many of them have been playing the game fairly. A few other non-metallic industries have their trade associations—the graphite, talc, phosphate, and several others, but a good opportunity exists among some of them to organize, particularly for the discussion of technical matters, in which there seems to be a lamentable secrecy.

The efficient exploitation of the non-metallic mineral resources of the United States, and the meeting of foreign competition, are partly contingent upon better technical processes, the elimination of waste, and a better understanding of marketing conditions. In some—one might say almost all—non-metallic industries a regrettable lack of standardization exists. A good method of clearing up these problems would be to organize the various units, small as they may be, into trade associations capable of acting for the entire group.

Whether the mining industries will remedy their lack of adequate organization in the near future is an interesting speculation. They have much to gain and nothing to lose by it. The tendency toward industrial co-operation as a means of effectuating an improvement in business methods is growing stronger every day. Manufacturers, to realize its advantages, have only to reflect upon the methods pursued by labor and agriculture, with their modern organizations. Magnanimity on the part of the strong producers and a sympathetic consideration of the position of the smaller ones will be required. Each will have to subordinate his own particular interest for the welfare of the entire industry, but that should not be a difficult condition to bring about, as it does not require great sacrifice.

If openly conducted, the trade association cannot help but command the respect and commendation of the American public, whose watchword in politics, athletics, and in practically every walk of life is teamwork—co-operation. Only lately has industry been applying the principles of organization, and the mining industries have played a part in the movement; but there is a good opportunity for further growth, and it is to be hoped that intensive development will follow.

Explorations in the Cuencame District, Durango

Alberto Terrones Benitez, of Durango City, Mexico, has recently been exploring near Pasaje, in the Cuencamé district, Durango. Here he found the remains of a mammoth at a place called La Cieneguita; the molar tooth with its ridged surface leaves no doubt as to the identity of the fossil. This was found close to the contact between the Quaternary formation and a conglomerate of the Upper Cretaceous. According to Mr. Terrones, it had not heretofore been considered probable that fossils of this kind could be found in this country, though subsequent investigation has shown that similar fossils have been found in the Nombre de Dios district, forty miles southeast. Exploration for more fossils is being continued. The country is said to be interesting. Great areas of level ground formed by conglomerates and limestones predominate, the latter showing schistose structure in some regions. This formation belongs to the Upper Cretaceous and has been cut at different places by extrusive volcanic flows, forming the mountain ranges where the mineralized zones have been discovered, like the Sierra de Yerbaniz (Orito mines), the Pozuelos mines, and the enormous deposits at Velardeña. Cerro Blanco, a huge mountain overlooking the country for hundreds of miles, seems to have been the focus of eruptive activity. The country around this mountain is entirely unexplored.

Comstock Lode Still Rich

Recently E. S. Bastin, of the U. S. Geological Survey, has made a microscopic study of the Comstock ores, and in his report, published as the Geological Survey's Bulletin 735-C, entitled "Bonanza ores of the Comstock Lode," he concludes that in the ores from depths greater than 500 ft., which include most of the bonanza ores of the lode, the silver is practically all in primary minerals. Descending solutions of surface origin produced a large increase in the silver content of certain ores obtained within 500 ft. or less of the surface, yet even at those depths a part of the silver is contained in primary minerals, and some rich ores taken from slight depths showed no secondary silver minerals. Gold, so far as observed, is primary in all the ores.

Although the deeper parts of the lode probably contain no orebodies comparable in size and richness to the great bonanzas of the past, the primary origin of some of the rich ores encourages deeper development.

USEFUL OPERATING IDEAS

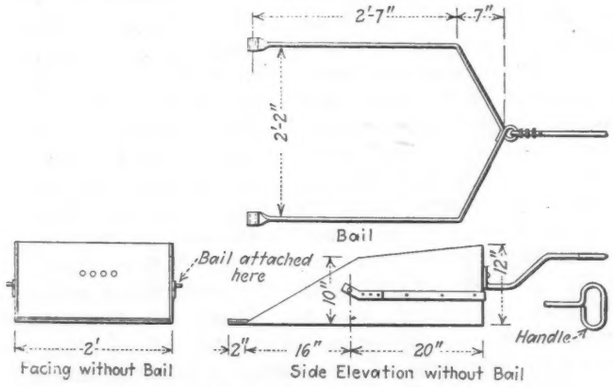
Use of Slip Scrapers in Carson Hill Mines

Cost of Spreading Stope Filling from Bottom of Finger Raises Cut About 60 Per Cent

BY FRANK S. FERRARIS

ONE of the most important labor-saving devices ever put into successful operation along the Mother Lode was the slip scraper used in the Morgan mine of the Carson Hill Gold Mines, Inc., at Melones, Cal. The hanging-wall stopes of the mine were filled from a glory hole on the summit of Carson Hill. A series of raises connected each stope to the glory hole. This series consisted of one main raise along the foot wall in the center of the stopes and extending to the glory hole. Finger raises were run from each end of every stope intersecting this main raise.

When the filling was needed on the south end of the stope, a bulkhead would be put over the north finger



Details of Carson Hill slip scraper

raise, which would cause the filling to go to the south end. The filling was broken in the glory hole by churn-drilling 10 to 12-ft. holes in benches and blasting directly into the main raise, which allowed the filling to drop into the stopes.

The foot walls of the stopes have an average pitch of about 50 deg. Much of the filling coming out of the finger raises piled up in the proper places, but the length and width of the stopes were such that it necessitated considerable hand mucking to fill the stopes so that the filling would parallel the roof of the stope. This system of filling was expensive, as high wages were paid to muckers, and labor was not only scarce but also inefficient, owing to conditions incident to the war.

It was decided to experiment with a device such as the slip scraper, and one was made in the company's shops. Two Ingersoll-Rand Tugger hoists were placed on a platform made of 2-in. plank and anchored against the hanging wall by drilling two holes into the hanging and driving two eye-bolts in the holes. A short piece of cable was used to fasten the platform to these bolts.

One of the tuggers was used for the forward pulling line and the other for the back line. Holes were drilled into the roof of the stopes and plugs inserted, to which snatch blocks were fastened for the cable to pass through. These blocks were moved whenever it became necessary to pull the filling to some other point in the stope.

The tuggers were set on the platforms so that one man could operate both of them from one position Cables ⅜ in. in diameter were used on both drums, which had a hoisting speed of 200 ft. per minute with a 90-lb. air pressure.

One man was required to handle the scraper. About half a ton of filling was moved every trip. A little difficulty was experienced at first in getting the bail fastened in the proper place. At first it was set back too close to the center, which allowed the scraper to turn over whenever it struck coarse material.

In building a scraper that is 3 ft. 2 in. in length (as shown in the illustration), it is necessary to have the bail fastened 1 ft. 4 in. back from the front end and 4 in. above the bottom. At this position it is easily dumped. A 50-lb. lift on the handle will dump the scraper when loaded.

The point or nose of scraper is the only wearing part. This is changeable and can be removed by cutting six rivets and a new point put on. The bail is made of 1-in. steel, and is 3 ft. 2 in. long. A shorter bail could be used, but if it is too short it tends to prevent the scraper from getting a full load within a distance of a few feet. The complete scraper, with its bail, weighs approximately 100 lb. if made of ¼-in. sheet steel.

With the two men which are needed to operate this scraper, about 100 tons of filling can be moved in one eight-hour shift to a distance of 50 ft. Use of the scraper has cut the filling cost about 60 per cent at this property.

Assay of Battery Chips for Gold and Silver

BY JOHN WATSON

During the last two years I have often been called upon to make arbitration assays for a central reduction works on the Rand. The following notes may be useful to those who have to carry out such determinations:

The material assayed contains a miscellaneous assortment of chips from steel shoes and dies, pieces of old screening and the like from the mill, enriched often by beads of amalgam. At the reduction works, a fair average sample, taken in the presence of the vendor's representative, is ground fine enough to pass through a 10-mesh screen. The whole is then thoroughly mixed, after drying, if necessary, and portions are sealed for assay by the respective parties, who retain one or two extra parts for arbitration. If a greater difference than 5 per cent is found to exist between the assay values of buyer and seller, it is customary on the Rand to send a sample for arbitration.

The following charge will be found to give a good fusion:

Sample	½ A.T.	Borax, anhydrous	½ A.T.
Sodium carbonate	½ A.T.	Red lead	2 A.T.
Silica (free from gold or silver)	½ A.T.	Cornmeal, flour, or charcoal	1/10 A.T.

Owing to the coarseness of the sample and possible presence of amalgam, at least six different portions should be fused, and the average result reported. In weighing out the flux it saves time to weigh first six portions of ½ A. T. each or 3 A. T. of sodium carbonate and place in a clean shallow dish, following with six times the quantities given above of the other components. The whole flux is then put through a 40-mesh screen and thoroughly mixed.

In weighing out the charge 3.60 A. T. mixed flux is placed in a Wedgwood mortar, then ½ A. T. of the sample is added, the whole ground well together, then transferred to the fire-clay crucible, the mortar being cleaned out each time with a little Na_2CO_3, which can be added as a cover to the charge. About half an hour's fusion, at a fairly bright red heat, will be required, when the contents (if sufficiently fluid) may be poured into iron slag-molds, well cleaned and slightly greased. The weight of lead reduced will be of a convenient size for cupellation, in cupels of say 70 g. absorption. After cupellation, each bead of bullion is weighed, 2½ times its weight of pure assay silver added, rolled up in lead-foil and re-inquarted. The parting is carried out in nitric acid of 1.21 specific gravity, heated to boiling point or nearly so. The boiling must be continued until all silver is dissolved. In the treatment of very rich samples, it may be necessary to boil again in nitric acid of 1.31 specific gravity, though such operations are comparatively rare.

Shaft Arrangements for Hoisting

The prevailing rectangular timbered shaft is usually equipped with wooden guides. These are dressed timbers 4 x 4, 4 x 6, 6 x 6, or 6 x 8 in. in dimensions. They are three or four sets in length and are attached to the wall plates and dividers by countersunk lag-screws. Two guides are necessary in each compartment. In place of wooden guides, steel rails and iron channels are sometimes used. In shafts of circular section the guides are wooden or of wire rope. In German colliery shafts, the guides are placed at either end of the cage and have to be interrupted at the landings to permit entrance to the cage. They are exceedingly awkward in this position.

Rope guides are used in English collieries. The guide is 1⅛ to 1¼ in. in diameter and may be a locked-coil cable or a rope made of seven bars or wires. The locked-coil guide cable is made of seven large wires and an outer shell of round and lock wires. Three to four rope guides are required for each cage. The cages are given a clearance between each other of 12 to 18 in. and to prevent the possibility of their colliding, fenders are attached at the top and bottom of each cage and two guard cables placed in the shaft between the cages. The guides are attached to the headframe and hang free from all attachments in the shaft. At the bottom they are prevented from swaying by straps which hold them against buntons but leave them free to move up and down. Heavy cast-iron weights are attached to the guides and place them under sufficient tension to cause them to act like a rigid bar.

Safety catches cannot be used with metal guides, and wooden guides must be made of generous dimensions and securely fastened to make them effective. The Butte practice of placing studdles back of the guides in the shaft sets is excellent. In inclines, the skips are supported on a track fastened to the wall plates. A guard rail is not infrequently placed above the skip wheels in such a position as to prevent the skip from leaving the rails. Where this is not done, timber guides on the sides of the skip are advisable. Safety catches are occasionally seen in incline shafts, and are no doubt effective.

It was formerly the custom to equip with landing chairs all landing places in shafts used for cage hoisting, but practice has rendered them more or less obsolete except at the topmost or surface landing. When installed at levels they are an element of danger, as they may be left accidentally projecting into the shaft and be struck by the cage as it descends.

A manila or, preferably, a galvanized wire rope is installed in the corner of each compartment on the loading side of the cages. A ½- or ¾-in. manila rope or a ¼- or ⅜-in. wire rope, depending on the depth, is usually selected. It is held in place by cleats which prevent it from swaying (cleats are placed at 100 to 200 ft. intervals). The upper end is attached to a counterbalance bell crank and the vertical arm of the bell crank is attached to the wire leading to the bell. The manila-rope pull is satisfactory enough for shallow shafts, but for depths exceeding 1,500 ft. it is a clumsy device. The wire rope is efficient for much greater depths, but for depths exceeding 2,500 ft. the electrical signal system is preferable. Rope pulls are usually installed in shafts for emergency signaling purposes. Electrical signaling systems co-ordinated with lamp flashes and supplemented by a telephone have been developed, and are efficient and satisfactory for shafts of all depths.

The pneumatic whistle and bell are used in one-level shafts of moderate depth. The device can also be used from different levels, each level being similarly equipped. The installation consists of a 1½- or 2-in. pipe in each compartment. At the hoisting engine the pipe terminates in a whistle or pneumatically operated bell. At each station a short pneumatic cylinder and whistle or bell is placed. Striking the plunger of the cylinder a sharp blow with the hand sends a wave of air through the system, operating the whistles or bells. The pipe can also be used as a speaking tube. The system works satisfactorily and is used at many collieries.

Use of Spring Draw-heads in Hoisting

To reduce the shock of starting, spring draw-heads are sometimes used. In its simplest form the spring draw-head consists of a heavy coiled spring like a car spring. The draw-head extends through the spring, and a heavy plate bolted thereto compresses the spring against the main frame of the cage. Spring draw-heads are desirable, although not universally used in hoisting practice.

Wedge Fastenings for Attaching Ropes

Wedge fastenings are in use on hoisting ropes in some districts, and particularly in England and Germany. They have the advantage of providing a large contact surface, and can be readily changed when this is necessary.

THE PETROLEUM INDUSTRY

Petroleum Refineries Ran at 76 per Cent of Capacity in February—Gasoline Stocks Greatest on Record

THE 296 operative refineries in the United States ran a daily average of 1,361,000 bbl. of oil through their stills during February, 1922, this being 76 per cent of their rated daily average capacity. The daily average run for the 291 plants in operation during February, 1921, was 1,340,000 bbl. An average daily increase of 21,000 bbl. run to the stills is shown over February a year ago, according to figures compiled by H. J. Lowe, petroleum economist for the U. S. Bureau of Mines.

An increase of four plants in the number operating and a daily average increase of 42,000 bbl. in capacity is shown in the totals for the month. All figures are in gallons.

GASOLINE—COMPARATIVE STATISTICS

	February 1922	January 1922	February 1921
Stocks first of month	705,711,191	586,087,132	571,983,793
Production	398,223,146	444,622,783	388,188,252
Imports	4,979,625	8,250,393	2,597,348
Total	1,108,913,962	1,038,960,318	962,769,393
Exports	38,169,593	49,856,310	52,497,051
Shipped to insular possessions	439,376	675,659	4,536,619
Domestic consumption	251,759,440	282,717,168	225,195,372
Stocks end of month	818,545,553	705,711,191	680,540,351
Total	1,108,913,962	1,038,960,318	962,769,393
Daily average production (*a*)	14,400,099	14,608,812	13,956,628
Daily average consumption (*b*)	10,370,300	10,749,972	10,079,609
Excess production over consumption	4,029,799	3,858,840	3,877,019

(*a*) Including imports
(*b*) Including exports and shipments to insular possessions.

Gasoline stocks total 818,500,000 gal. and show an increase of 112,800,000 gal. over the reserve the last of January. This is the greatest reserve in the history of the industry, exceeding by 18,000,000 gal. the previous high figure set in May, 1921. At the present rate of increase in storage it is possible that the billion-gallon point may be reached in the gasoline reserve before the seasonal decline in stocks commences. The amount now in storage is 138,000,000 gal. more than on March 1 a year ago. Production during February totaled 46,000,000 gal. less than for January, but showed a 10,000-gal. increase over February a year ago.

KEROSENE—COMPARATIVE STATISTICS

	February 1922	January 1922	February 1921
Output	167,220,226	172,917,142	163,081,918
Daily average	5,972,151	5,577,972	5,824,354
Stocks end of month	332,330,245	327,484,281	430,045,193

Stocks of kerosene increased 5,000,000 gal. during January. Exports decreased from 81,100,000 gal. in January to 61,450,000 gal. in February.

GAS AND FUEL OIL—COMPARATIVE STATISTICS

	February 1922	January 1922	December 1921
Output	761,085,329	858,110,877	865,769,078
Daily average	27,181,619	27,680,996	27,928,035
Stocks	1,314,740,284	1,319,481,359	1,331,265,439

The above table indicates a slight decrease in both output and stocks of gas and fuel oils during the last three months. Present storage, however, is 322,000,000 gal. greater than a year ago.

The daily average production of lubricating oils during February was 2,469,000 gal., this figure being an average of 71,000 gal. more per day that for January. Stocks also increased from 245,000,000 gal. to 260,000,000 gal. during the month. This figure is the highest since June, 1921, when a similar storage was attained, and lacks but 2,000,000 gal. of the high point reached in the storage of lubricating oils attained in May, 1921.

Cabinet Officials Explain Teapot Oil Lease

Replying to the Kendrick resolution for information as to details of the lease of naval petroleum reserves in California and Wyoming, Acting Secretary of Interior Finney and Secretary of the Navy Denby, in a joint letter to the Senate, explain that the action is in accordance with previous Congressional authority and that it is conducive to conservation.

They cite a provision in the naval law of 1920 which authorized the Secretary of the Navy, "to conserve, develop, use, and operate" the oil reserves "directly or by contract, lease, or otherwise, and to use, store, exchange, or sell the oil and gas products thereof." They say their action is in accordance with the purposes for which the reserves were created—i. e., "not the sale of oil for commercial or other purposes, but the securing of a reserve of fuel oil for Navy purposes."

The officials point out that the contract with the Mammoth Oil Co., headed by H. F. Sinclair, covers the entire Wyoming reserve; and that royalties to the Government will be as high as 50 per cent, according to production and specific gravity of the oil. The contract calls for drilling twenty wells; the construction of a pipe line from the field to existing pipe lines in Missouri; for the exchange of crude for fuel oils, the latter for naval purposes; and for the delivery of Navy specific oil at points designated by the Navy, from Guantanomo, Cuba, to the northeast corner of the United States. It provides for a line of credit under which, in exchange for the crude oil, ample storage for the fuel oil is to be provided, without cash outlay by the Government, at any point fixed by the Navy Department along the coast described. It provides that the lessee shall at such or any other points, at its own expense and without obligation on the part of the Navy, provide gasoline, kerosene, lubricating, and cylinder oil at market prices. It provides prior right of transportation for all governmental oils from not only the Teapot (Wyoming) dome but from the Salt Creek field, even prior to the uses of the pipe line by the lessee. It makes the pipe line, when built, a common carrier for all Government oils. The pipe line already constructed, with which the new pipe line will connect, involved a present investment of $115,000,000, and this contract calls for an investment on the part of the lessee of not less than $26,000,000 additional. Furthermore, the contract will

bring about immediate competition in the Salt Creek field and will add from 40c. to 60c. per barrel to the present prices of Government royalty oils, now amounting to more than 5,000 bbl. per day. This is secured by an option given the Government to sell royalty oil on basis of Mid-continent prices, if and when desired.

The production from the Salt Creek field at present is about 40 per cent of the capacity of existing wells, which will be immediately raised to 100 per cent, yielding to the Government for reclamation, state, and Treasury purposes approximately 12,000 bbl. of oil per day, with an added value thereto of from 40c. to 60c. per barrel or, in other words, that added price over and above the amount which the Government and independent producers are now receiving.

In connection with the Teapot Dome lease, attention is called to the fact that, under the terms of exchange, the Navy will secure its fuel oil at a rate 5 per cent more favorable than fuel oil has cost the Navy through a long term of years in the past. In addition, it is getting a mid-continental price in Wyoming. The prices differential has varied from 60c. to $1.25.

Kendrick Bill To Fix Wyoming Naval Oil Royalties

WASHINGTON CORRESPONDENCE

Under a bill introduced by Senator Kendrick, of Wyoming, that state will be given not less than 5 per cent royalty of all oil and gas produced from Naval Petroleum Reserve No. 3, Wyoming Reserve No. 1, known as the Teapot Dome. The royalty to the state will not be based on oil and gas used for production purposes on the reserve or unavoidably lost.

Admiral Robison, chief of the Navy Bureau of Engineering, recommended to the House Appropriations Committee that his bureau be given charge of the care and preservation of naval petroleum reserves, heretofore under direction of the Interior Department. He says this arrangement will be satisfactory to the Interior Department. He recommended appropriations of from $50,000 to $100,000 to supervise the reserves.

The Navy Department's bureau of experiment and research in investigations to reduce oil consumption is working on eliminating fouling, which it is said adds to the amount of fuel used.

Colorado Land Commissioners Encourage Oil Exploration

SPECIAL CORRESPONDENCE

The Colorado State Board of Land Commissioners is offering all possible encouragement to oil men for the exploration of state lands. Liberal concessions have been granted in allowing large areas to be attached to tracts on which drilling is being done. These concessions are made to encourage drilling on state land, with the hope of opening up an oil field, the royalties from which might greatly increase the state school fund to which all proceeds from state lands revert.

Among the wells now drilling on state lands are the Nee-No-She, midway between Eads and Lamar; the Flagler well, in Kit Carson County; the Wigwam, in El Paso County; the Midfields, in Yuma County, and the Frantz well, near Steamboat Springs.

Prospecting for Oil in Australia

SPECIAL CORRESPONDENCE

A number of discoveries of petroleum have recently been reported both in Queensland and other states of the Australian Commonwealth, but so far nothing definite has resulted. The latest report in Queensland was from the Tambo-Blackall district, northwest of Roma, where distinct traces of oil were proved some time ago at a depth of 3,700 ft. The first newspaper reports of the so-called find near Tambo stated that oil had actually been found in four bores, but a government geologist who was sent out to make an examination considers that the oil present in the shales obtained from the bores has been produced from animal matter and has not migrated into those shales from a deeper source. Moreover, he is of the opinion that the geological structure of the region is not favorable to the formation of oil pools.

A report from the government analyst on a sample of slurry taken from the bore of the Queensland Oil Co., Ltd., at Woolston, near Brisbane, where operations have for some time been conducted upon the faith of a "diviner," states that this sample had a marked odor of kerosene. It contained many minute particles of black shale, which, on being collected, dried, and heated, gave off a little oil in the usual way. On a part of the sample being extracted with ether, instead of only traces of crude oil being found, as is usual, indications of a fairly clean oil were obtained, but there was not sufficient oil to determine its nature.

The federal government has expressed its readiness to co-operate with the Queensland government in boring for oil in the Roma district, subject to a favorable report from the geological experts of the Anglo-Persian Oil Co.

The task of boring past the obstruction in the Queensland Roma bore by deflecting from the old hole from a depth of about 2,500 ft. is being continued, but the work is reported to be proceeding slowly, on account of the difficult nature of the operation. It has been officially stated that if this method does not prove successful—and there seems to be every likelihood that it will not be—the petroleum gas previously discovered in this bore will be utilized for power and lighting purposes on a commercial scale, but in this connection it should be understood that the force and pressure of water in the original hole were so great that the gas could not be recovered after it had been shut off.

Both in Victoria and Western Australia government geologists have reported against the probability of oil being discovered in those states, but the companies which have taken up large prospecting areas in the hope of securing the commonwealth bonus of £50,000 are by no means content to be guided by these adverse opinions. One Victorian company holding leases in Western Australia, covering an area of 10,000 acres, and which must go on boring or forfeit them, five or six weeks ago decided to raise more capital and engage a Russian oil geologist (Captain E. de Hautpick), who was in Melbourne at the time, to examine and advise on the company's holdings. Presumably Captain de Hautpick, who is described as "a Russian scientist who has made a life-long study of matters associated with the discovery of petroleum," and who has had practical experience in both America and Russia, is now engaged in that work.

Further Prospecting for Oil In Southern Oklahoma Warranted

Geological Structure Is Complicated and Requires Careful Study — Test Wells Have Shown That Sundry Beds Are Oil Bearing

THE development of the Healdton pool, in Carter County, Okla., discovered in 1914, showed that the region between the Arbuckle and Wichita Mountains on the north and the Red River on the south undoubtedly contains great reserves of oil. The subsequent development of the Hewett and Walters fields and of a number of others of less output proved that the Healdton was not the only highly productive pool in this region, but that it is reasonable to expect that others will be discovered. Numerous test wells scattered over Stephens, Cotton, Jefferson, Carter, and Love counties have struck oil and gas in some quantity. Many of these wells were drilled by companies whose funds were sufficient to complete only one well, so that even if a company obtained favorable showings in its single well it was unable to do further drilling, which might have found larger volumes of oil, according to a statement issued by the U. S. Geological Survey.

This region undoubtedly merits careful and thorough prospecting, but the business risk is great. The interpretation of the geologic structure by a study of the surface exposures is everywhere difficult and in many places impossible, and even where the structure can be determined approximately it may be impossible to select accurately the most favorable localities for drilling. In this connection the history of the discovery of the Healdton pool is instructive. The discovery well happened to strike the very edge of the pool, but if it had been drilled 300 ft. farther south this great pool probably would not have been opened. The development of this region has been retarded also by the nature of the beds, whose tendency to cave has caused prospectors to use rotary tools in many places and thus to increase greatly the danger that they might drill through oil-bearing sands without detecting the oil.

Wildcatting in this area should obviously be restricted, for the present at least, to territory that appears geologically more favorable than the average, and the few known geologic facts should be put to the utmost possible use. One area that merits the consideration of the oil operator lies in southern Jefferson County, in one of the bends of the Red River. It has been briefly described by Heath M. Robinson, of the U. S. Geological Survey, in Bulletin 726-F. Only a small part of the area considered in the report contains outcrops of beds that permit the determination of the structure, but such observations as could be made showed the presence of four anticlines. In his report Mr. Robinson suggests a number of locations for testing these anticlines, and other good locations may be inferred from a study of the map that is included in it. The area considered in the report is about eighteen miles southwest of the Healdton field, twenty-five miles southeast of the Walters field, and eighteen miles due east of the Petrolia field, in Texas. The beds that yield oil in the Petrolia field underlie the surface in the southern part of Jefferson County, at depths of 2,000 ft. or less, and the showings of oil obtained in the wells that have been drilled to these beds prove that they are oil bearing there.

Bituminous Shales of Western New York Are Too Low Grade for Exploitation

BY BENJAMIN J. HATMAKER

In the course of a survey of the natural-gas fields of western New York the suggestion was made that an investigation be extended to cover the thick-bedded bituminous shales which outcrop in the Buffalo Quadrangle and in adjacent areas. This work seemed worth while, for the reason that in Kentucky the shales of the same age, the Devonic, yield commercial amounts of oil and gas. Gilbert and Pogue, in "America's Power Resources," map this region as one of the principal oil-shale areas of the United States. The five shales investigated were the Marcellus, the Middlesex, the Rhinestreet, the Hanover, and the Dunkirk. These were sampled at various points along typical outcrops and the samples assayed with an apparatus designed and recommended by the Bureau of Mines. The oil contained varied from 0.8 to 3.29 gal. per ton and an average of all the samples analyzed showed 2.36 gal. per ton.

For the purpose of checking the work and making further investigation into the amount and character of the gas yielded, a sample of 50 lb. of Marcellus shale, which showed the largest yield of gas, was shipped to the Pittsburgh Experiment Station of the Bureau of Mines. The report of this test showed these shales to yield 2,004 cu.ft. of gas, 5 lb. tar, 3.2 gal. oil, and 6.3 gal. of water, with a residue of 1,786 lb. per ton. No distillation tests were made from the small quantity of oil produced further than to determine the asphaltic character of the residue.

It is evident that the bituminous shales of western New York should be eliminated from our present fuel reserves.

Small Production From Fort Norman Well

Superintendent Jennings of the Mounted Police at Edmonton has received a report from Staff Sergeant Clay, in charge of the Fort Norman detachment dealing with oil operations. About 10 bbl. per week has been secured from the well of the Imperial Oil Co. The well will be put down deeper. The company has four drills in the field, with machinery in place—one west of Fort Norman, one at Bear Island, one on the Mackenzie River, and one a short distance from the mouth of Bluefish Creek.

The Fort Norman Oil Co. will this spring resume work on the well, put down 1,000 ft. last fall. This is situated seven miles above the Imperial company's No. 1 camp.

Oil Well Drilling in Arizona

SPECIAL CORRESPONDENCE

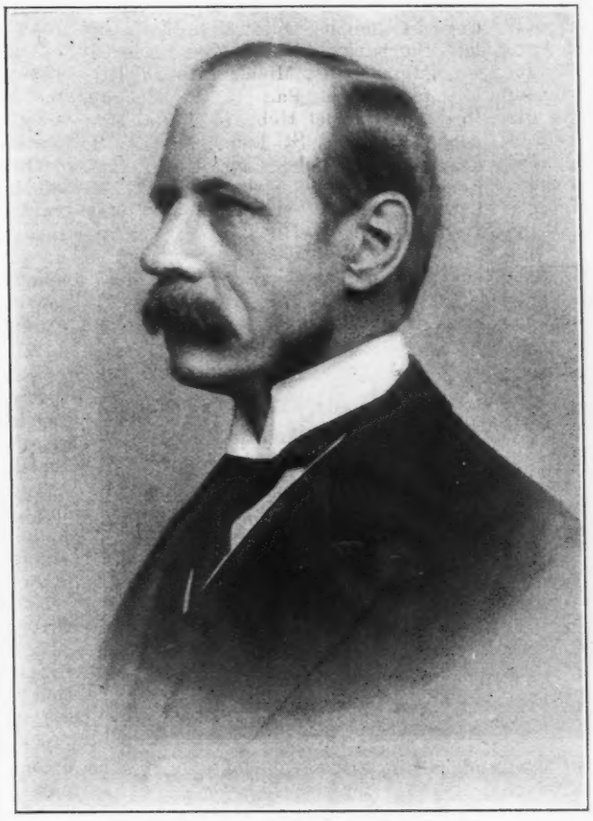
Drilling about thirty miles northwest of Phœnix, Ariz., at a depth approximating 3,000 ft. is reported to have found oil sand, though the operations, conducted by the Tannehill interests of Bakersfield, have been with notable absence of publicity. A section of the bore has had to be cemented. The rig of the United States Oil & Refining Co., near Bowie, is being moved by a Nogales company to a new field, southwest of Tombstone, near Elgin.

Mining Engineers of Note

WALTER McDERMOTT

BY EDGAR P. RATHBONE

FIFTY years ago the development of the mines of the American continent had hardly begun, and mining engineers of ability were scarce. Americans had to depend on some outside talent, and British engineers, with their background of centuries of mining experience, found here a fertile field for their endeavors. Walter McDermott was one of the most prominent of these. Born in London in 1851, he came to this continent twenty years later to report on some silver discoveries on the north shore of Lake Superior. He took special interest in the then famous Silver Islet mine, where he became assayer. This outcrop was just under the water-level of Lake Superior on a crag of diorite, about 70 x 80 ft., forming an islet three-quarters of a mile from the mainland. As any serious storm inundated the island, an artificial island had to be built up by wooden cribbing filled with rock blasted out on the mainland and transported by scows. A water-tight cofferdam was then built on the outcrop of the vein and a permanent shaft sunk. It is of interest to note that only recently this property has been reopened, but it is understood that the undertaking so far has been unsuccessful.



WALTER McDERMOTT

Among the other properties examined by Mr. McDermott two are worth mentioning. Several gold-bearing veins in the Jackfish Bay district were sufficiently promising to be worked for a short time. Tellurides of gold and silver were present, probably the earliest working of such ores on the American continent. The other property was also interesting as being responsible for the first American excitement about tin. A company had been formed in Detroit to develop a supposed discovery of tin made just before navigation closed. English capitalists heard of the project and suggested to Mr. McDermott that he take up claims around the discovery. With snowshoes and dog sleds, and accompanied by a surveyor and some Indians, he made the journey 150 miles east along the lake shore, where he found that some Cornish mining men from the Michigan copper country had supplied the omissions of nature by filling suitable crevices with a mixture of tinstone from the Cornish mines and tailings from the concentration mills. An Indian who had been working with the original discoverers mentioned that something was buried under the camp, and on digging, a barrel was found containing soluble silica.

The rich hand-picked Silver Islet ore, averaging 2,000 oz. per ton, was shipped during navigation to smelting works at Wyandotte, near Detroit. Experiments made at the mine by the manager, W. B. Frue, and Mr. McDermott, resulted in the joint invention of the Frue vanner. A fifty-stamp mill was then erected on the mainland, with twenty-four Frue vanners, which was highly successful. In introducing the Frue vanner, Mr. McDermott came into close relations with Messrs. Fraser & Chalmers, of Chicago. This connection resulted in his erecting and running ore-testing works in New York, and later in his appointment as managing director of Messrs. Fraser & Chalmers, Ltd., an English company which purchased the Chicago machinery business and built works in England. For several years Mr. McDermott traveled all over the Western states, examining mining properties for Detroit capitalists and purchasing lead and silver ores for the Wyandotte smelter. The purchase of two gold mines in Montana, the Penobscot and Belmont, resulted in his settling down for some time as manager of the last named.

Mr. McDermott took an active part in the formation of the Institution of Mining and Metallurgy, was president in 1898-99, and later was made a gold medalist. He has also represented the Institution on the Board of Governors of the Imperial College of Science and Technology ever since the reorganization of the Royal School of Mines, and designed and superintended the equipment of the "Bessemer" laboratory of the new school buildings, for the practical testing of ores.

Walter McDermott, with his partner the late P. W. Duffield, published a small book on "Treatment of Gold Ores" in 1890; also, a book on "Mining and Mining Investments" in 1904. He has contributed a number of papers to the *Transactions* of the Institution of Mining and Metallurgy, including one on "Mining Reports and Mine Salting," published Dec. 19, 1894.

SOCIETIES, ADDRESSES, AND REPORTS

Executives of Bureau of Mines Confer at Pittsburgh and Washington

The superintendents and principal clerks of the various experiment stations of the U. S. Bureau of Mines were in Washington during the week of April 17 to participate in a conference for the considerat on of various problems of an investigative or administrative nature. The sessions, which were held in the Interior Department building, consumed the three last days of the week, and followed a three-day conference held the first part of the week at the experiment station of the Bureau of M nes at Pittsburgh, Pa.

Meeting of Bureau of Mines officials at Pittsburgh, Pa.

Dorsey A. Lyon, supervisor of stations, presided at the conference, and addresses were made by Dr. H. Foster Bain, Director of the Bureau, and the various division chiefs of the bureau.

Those present from the experiment stations included H. H. Hill, superintendent, petroleum station, Bartlesville, Okla.; O. C. Ralston, superintendent, Pacific station, Berkeley, Cal.; W. R. Crane, superintendent, Southern station, Birmingham-Tuscaloosa, Ala.; R. T. Stull, superintendent, ceramic stat'on, Columbus, Ohio; J. A. Davis, superintendent, Alaska station, Fairbanks, Alaska; C. E. Julihn, superintendent, north central station, Minneapolis, Minn.; A. C. Fieldner, superintendent, Pittsburgh station, Pittsburgh, Pa.; S. C. Lind, superintendent, rare and precious metals station, Reno, Nev.; Thomas Varley, superintendent, intermountain station, Salt Lake City, Utah; C. E. Williams, superintendent, Northwest station, Seattle, Wash.; C. E. Van Barneveld, superintendent, Southwest station, Tucson, Ariz.; and J. J. Rutledge, superintendent, central district station, Urbana, Ill.

The principal clerks present were: John A. Rinehart, Bartlesville, Okla.; Mrs. Jessie Lamont, Berkeley, Cal.; Franklin Barr, Birmingham, Ala.; L. E. Geyer, Columbus, Ohio; Mrs. M. F. Gillett, Fairbanks, Alaska; Miss Susie Olson, Minneapolis, Minn.; Edward Taylor, Pittsburgh, Pa.; H. F. McCray, Reno, Nev.; Noel Hubbard, Rolla, Mo.; Albert L. Johns, St. Louis, Mo.; A. H. Clayton, Salt Lake City, Utah; Mrs. Edna S. Barrett, Seattle, Wash.; G. M. Babcock, Tucson. Ariz.; and Mrs. Mae Tulloch, Urbana. Ill.

Comptroller Urges Maintenance of Gold Basis

In the course of a public address on April 22, D. R. Crissinger, the Comptroller of the Currency, made the following statement:

"The United States continues the one first-class country that is maintaining its money system on a sound gold basis. To do this is the greatest immediate service we can do to the commercial world and to our own business. It is of the greatest importance that our currency and banking policies shall insure the maintenance of the high standard of American money in every financial center. If for a time, in order to accomplish this, the speculative interest rate shall be somewhat higher here than in some foreign markets, the ultimate results will be by no means unfortunate for our country. Better to maintain our position as the country with the soundest money system than to encourage any speculative movement which might threaten another era of inflation, and a consequent postponement of the day when the gold standard can once more be established and exchange permanently restored to its normal basis."

National Association Indicates Effective Aid to Slate Industry

To give the public greater knowledge concerning the advantages and economies in the use of slate, as well as to extend and promote the use of their product, a number of slate producers met at the Commodore Hotel, New York City, on April 20 and organized the National Slate Association.

Oliver Bowles, of the U. S. Bureau of Mines, pointed out some of the advantages that would accrue to the slate industry through the activities of such an organization. The ability to meet outside competition effectively is one of the most prominent advantages, for new competitors are constantly appearing.

W. A. Durgin, Chief of the Division of Simplified Practice of the U. S. Department of Commerce, outlined the service to industry his division was prepared to give. The report of W. H. Smith on the freight-rate situation showed that the production and marketing of slate are depressed more under a handicap of high freight costs than similar activities with regard to all other construction materials.

Sullivan W. Jones, chairman of the Structural Service Committee of the American Institute of Architects, on behalf of that body offered its co-operation to the producers of slate.

L. E. Kern, of the American Institute of Architects, also discussed co-operation among architects, producers, and the public. Mr. Couzins, of the Allied Wall Paper Industry; Mr. Darling, of *Rock Products;* Mr. Rockwood, of *National Builder;* Mr. James B. Stewart, of the New York *Times*, and several others discussed the various phases of the sound purposes of co-operative promotion of the use of materials.

The election of an executive committee to formulate an organization and the necessary details followed the unanimous decision to establish a national association. The following men were elected:

William H. Keenan, Bangor, Pa., chairman; G. H. Shinville, Fairhaven, Vt.; N. M. Male, Pen Argyl, Pa.; Roscoe C. Berlin, Slatington, Pa.; F. C. Sheldon, Granville, N. Y.; E. R. Norton, Granville, N. Y.; G. F. Barnard, Boston, Mass., vice-chairman; A. H. Morrow, treasurer, Pawlet, Vt.; W. S. Hays, secretary, Philadelphia, Pa.

The successful organization of this association is due largely to the untiring efforts, co-operation, and inspiration of Oliver Bowles, of the Bureau of Mines, who acted as presiding officer of the meeting, and also to the activities of William H. Smith, of Bangor, Pa.

MEN YOU SHOULD KNOW ABOUT

Seeley W. Mudd is in the Eastern states.

J. V. N. Dorr sailed for Europe on April 22.

H. V. Winchell and **L. W. Wickes** recently visited Randsburg, Cal.

A. H. Stebbins, of Los Angeles, was recently in Boston and New York.

A. H. Bishop and **R. H. Weir,** of Cleveland, recently visited the Gogebic Range.

W. R. Smith, of the U. S. Geological Survey, is working on an oil and gas map of Virginia.

H. C. George, of the petroleum division of the U. S. Bureau of Mines, is en route to Alaska.

Ernest Marquardt, chief geologist of the New York Oil Co., of Casper, Wyo., is in San Francisco.

L. D. Stewart, of the Ogleby, Norton & Co. staff in Ironwood, Mich., has gone to Hog Island, Philadelphia.

M. C. Lake, chief geologist for M. A. Hanna & Co., has been examining the Ashland mine at Ironwood, Mich.

F. L. Hess, of the U. S. Geological Survey, is in the field gathering data for the Division of Mineral Resources.

Frederic R. Weekes has returned to New York after a two months' trip to Venezuela on professional business.

B. B. Gottsberger has been appointed professor of mining at Yale University and is assigned to the Sheffield Scientific School.

Alfred James arrived in New York last week and will remain in this country for some time on professional business.

A. E. Fath, of the U. S. Geological Survey, has received the degree of doctor in geology from the University of Chicago.

F. E. Boyd, of Duluth, is now in charge of the patent department of the U. S. Steel Corporation in the Lake Superior district.

R. J. Parker, mining engineer, who has been in the Belgian Congo for the last three years, is in New York, on his way to Denver, Col.

H. G. Ferguson and **S. H. Cathcart** are en route to Nevada to do geologic work in the Tonopah Quadrangle for the U. S. Geological Survey.

M. R. Campbell is acting as administrative geologist of the U. S. Geological Survey during the absence from Washington of **Philip S. Smith.**

M. M. Duncan, vice-president and general manager of the Cleveland-Cliffs Iron Co., has returned to Ishpeming, Mich., from an extended visit in Florida.

E. S. Henley, of New York, was in Toronto recently in connection with the purchase of two Kirkland Lake properties on behalf of New York capitalists.

A. C. Brinker, who has been examining mining properties in northern Mexico, is now in New York. He expects to leave for California in about a month.

E. L. Stenger, formerly assistant superintendent of the Mountain Copper Co., at Keswick, Cal., has joined the engineering staff of the Candelaria Mines Co.

W. L. Wimmler, of the U. S. Bureau of Mines, is in San Francisco investigating placer mining and gold dredging, particularly in Alaska, in respect to methods and costs.

Corey C. Brayton, of the American Manganese Steel Co., has returned to San Francisco from an extended trip in northwest Canada. He stopped at Edmonton, Calgary, Trail, and other points.

Dr. Charles Camsell, Canadian Deputy Minister of Mines, has been awarded the Murchison grant by the Royal Geographical Society of Great Britain, in recognition of distinguished service in exploration.

Kenneth A. G. Shearer and **Alberto Terrones Benitez** will soon undertake a survey of the Guanaceví camp, in Mexico, for the purpose of obtaining a map showing all the mining-claims, and topographical and geological features.

M. G. Edwards, assistant superintendent of the Cerro de Pasco Copper Corporation at Morococha, Peru, sailed from Peru for San Francisco on April 7. Mr. Edwards has been with this corporation in South America for the last five years.

Kurd H. Endell, professor of economic engineering at the Technical High School of Berlin, Germany, recently made an inspection of many of the open pits and underground properties on the Mesabi iron range in Minnesota and the iron-ore loading docks at Duluth and Superior.

R. C. Lane, who has been connected with the subsidiary operations of the United Verde Copper Co. for twenty years, has resigned and will go to the Pacific Coast. He was the honored guest at a dinner at Clarkdale, the host of which was **R. S. Condit,** of New York, auditor for the company.

C. M. Haight, mine superintendent of the New Jersey Zinc Co. at Franklin Furnace, N. J., on April 20 delivered a lecture on the mining methods of the company before the senior class of the Columbia University School of Mines. He was assisted by **A. G. Watt,** mine foreman, and **R. H. Seip,** safety engineer of the company.

H. A. Cardoza, vice-president of the Dives Refining & Copper Manufacturing Co., of Paris, France, was a guest recently of **J. S. Douglas,** president of the United Verde Extension Mining Co., and with him motored from Jerome to Miami, where the mill of the Inspiration Co. was inspected. Another visitor to the Inspiration plant was **M. B. Gentry,** general manager of the Santiago Mining Co., an Anaconda property in the Andes back of Valparaiso, Chile. Mr. Gentry will sail soon from New York for South America.

Mining and metallurgical engineers visiting New York City last week included: **Albert L. Colby,** of Bethlehem, Pa.; **J. S. Fried,** of Pittsburgh, Pa.; **W. A. Schmidt,** of Los Angeles, Cal.; **H. W. Gillett,** of Ithaca, N. Y.; and **C. E. Van Barneveld,** of Tucson, Ariz.

SOCIETY MEETINGS ANNOUNCED

The annual meeting of the **Iron and Steel Institute** will be held at the Institution of Civil Engineers, Great George St., Westminster, London, on May 4 and 5.

The annual dinner and meeting of **The Alumni Association of the Schools of Mines, Engineering and Chemistry** of Columbia University will be held at the Columbia University Club, 4 West 43d St., New York, on May 4.

The regular monthly meeting of the New York Section of the **American Institute of Mining and Metallurgical Engineers will be held on May 3,** at the Machinery Club, New York City. **E. P. Mathewson** will give a talk on India, China, and Japan. **C. W. Van Law** will speak about Peru. Both talks will be illustrated with lantern slides.

OBITUARY

William H. Dahneke, of North San Juan, who went to Alaska a few years ago, died on March 31, in the Dawson region.

John Richards, mine superintendent of the Alaska Juneau Mining Co., died on April 10. Mr. Richards was connected with the Alaska Treadwell and other mines for more than twenty-five years. He was a former president of the Alaskan Society of Mining Engineers.

William Newton Best, president of the W. N. Best Furnace and Burner Corporation, died on April 11 at his home in Brooklyn, N. Y. He was in his sixty-second year. Mr. Best was born in Quincy, Ill., and had devoted the greater part of his lifetime to the invention of devices for burning oil for heat.

Henry Monell, veteran prospector and mine operator, died at Boulder, Col., on March 7. Mr. Monell was born at Bellvale, N. Y., on July 15, 1847. In 1872 he settled in Boulder, where he became interested in the local mines and in ranching. He also had mining experience in Mexico, Arizona, and the Northwest.

New Books

The Commercial Side of Petroleum

The Economics of Petroleum. By Joseph E. Pogue. John Wiley & Sons, Inc., New York, 1921. $6.

This is a valuable volume, and illuminates the fundamental conditions of the petroleum industry. Twenty-nine short chapters develop succinctly the following subjects: The economic organization of the petroleum industry; the resource situation; the trend of oil production; the transportation of crude petroleum; the trend of refinery practice; the analyses of refinery capacity; the outlook for oil refining; gasoline; kerosene; fuel oil; lubricating oils; petroleum by-products; natural gas and natural-gas gasoline; marketing of petroleum products; analyses of the exports of petroleum products; prices of petroleum and its products; relation between price and production of crude petroleum; the bearing of automotive transportation upon the oil industry; the economic significance of cracking; composite motor-fuels; the motor-fuel problem; the city-gas problem; international aspects of petroleum; Mexico as a source of petroleum; the relation of the coal industry to the oil industry; oil shale; full utilization of petroleum; and the function of statistics in the petroleum industry. The book is well illustrated and well written, and mining engineers and others who keep in touch with the petroleum industry will be interested in reading the volume and having it close at hand.

The German Iron Industry

Die Eisen und Manganerze Osteuropas (The Iron and Manganese Ores of Eastern Europe). By George Behagel. B. G. Teubner, Leipzig, 1922. $8.

This volume is one of a series dealing with the mining and smelting of metallic ores, but the present book concerns especially the industrial problems of Germany relative to other states, with respect to iron and manganese. In the preface, the author states: "The justification, perhaps also the necessity, of the present volume, arises from the need to which Germany has been brought by the War, to survey the world market for new sources of raw materials." The author adds that, industrially, Eastern Europe is the first field to survey, as is evident "from the nature and the development of German industrial life, and from the present position of Germany relative to other states, and their relations to one another." Thus the volume deserves a place with the increasing list of works on "political and commercial geology"; and it shows clearly the current trend of German thought toward an industrial alliance with Russia.

The first part of the volume has to deal with the occurrence and mining of the ores, considered by regions, including Russia and the Caucasus, Poland, the Balkan territories, and Asia Minor. The second part considers the industrial distribution and the utilization of the ores.

The author concludes (p. 346) that beyond question "Germany must keep her eye on the Russian iron ores and take an active part in their further attainment," although it will not be possible to draw from these very soon, and at the moment it is impossible. In the meantime, the author finds that the German iron-furnace industry is sure of the superfluous ores of Austria; that Czecho-Slovakia will need all her supplies for home consumption; but that Jugo-Slavia is a very important region for Germany to develop, for immediate relief. Next to Jugo-Slavia, the prospective supplies of Greece rank in importance. "But, together with the pursuing of these earlier attainable ends, must be kept in mind, now and later, when the situation clears up, the great problem of the future, which finds its solution in Russia." J. E. S.

Petrography Up to Date

Petrographic Methods and Calculations. By Arthur Holmes. D. Van Nostrand Co., New York, 1921. $6.

This is a handbook which geologists and students of geology will be glad to add to their library, embodying, as it does, the most advanced methods and conclusions in the study of rocks. The various chapters treat of petrology, its scope, aims, and application; the specific gravity of minerals and rocks; the separation of minerals; the optical examination of crushed and detrital minerals; the examination of detrital sediments; the preparation of thin sections; microchemical and staining methods; the examination of thin sections; textures and structures of igneous and metamorphic rocks; chemical analyses and their interpretation; and the graphical representation of chemical analyses.

The author also points out that "the value and importance of petrographic methods in relation to industries have not been forgotten; and while exigencies of space have prevented more than passing reference to economical applications, I hope that these may prove sufficient to indicate to chemists, engineers, and others that the methods of work devised by the petrologist are competent to attack many of the problems with which they are faced, and are worthy of greater recognition than they have received in the past."

J. E. S.

American Mining Congress—Vol. 25 of the *Proceedings* of the American Mining Congress is now available as a 863-page book from the American Mining Congress, Munsey Building, Washington, D. C. The volume is a report of the twenty-fourth annual convention held in Chicago last October.

Technical Papers

Industrial Research Laboratories—A list of practically all of the more important industrial research laboratories in the United States, together with the name of the chief of the research staff and the number of assistants employed, the character of work done, and the equipment, is contained in the December *Bulletin* of the National Research Council (Washington, D. C.; price, $2). The book is thoroughly cross-indexed and will prove valuable to those who have problems which they wish to solve and who desire a list of names of research laboratories where their work may be done. About seventy firms are listed which carry on investigations in the realm of metallurgy and metallography.

Magnesite in Washington—The State of Washington came to the fore in the production of magnesite during the war, when foreign supplies were cut off. Though the largest user of magnesite in the world, only about 4 per cen was produced in this country before 1914. The Washington Geological Survey has issued a most informative monograph on the entire subject, discussing the deposits of the state, the reduction of magnesite for refractory and other uses, and research work in the application of magnesite in new fields. The economic situation is also mentioned. Two bibliographies, one on the geology and occurrence of magnesite and the other covering the preparation and utilization of this mineral, are appended. The book may be obtained from the State Librarian, Olympia, Wash., for $1.

Mongolian Gold Placers—A group of gold placer claims on the Kudara, Kuitun, and Iro rivers, in Mongolia, China, are described in a twelve-page paper issued by the U. S. Department of Commerce. (Obtainable on request for Trade Information Bulletin No. 4, Far Eastern Division, from the Bureau of Foreign and Domestic Commerce, Washington, D. C.) The placers lie in an area extending about fifty miles northeast and southwest by thirty miles northwest and southeast, with the southeastern end of the area about 100 miles north of Urga, and the northeastern end ten miles from the Siberian border.

Drop Shaft Sinking—Details of the sinking of a solid timber shaft on the Cuyuna Iron Range at Woodrow, Minn., are described in an eight-page paper in the February *Bulletin* of the Canadian Institute of Mining and Metallurgy (503 Drummond Building, Montreal). The price of the separate is 25c.

Helium—The April issue of *Natural Gas* (Cincinnati; 25c.) contains an exhaustive article by R. B. Moore on the history, production, and use of this element.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

COAL stocks are decreasing faster than was anticipated. The I. C. C.'s failure to pass on freight rates is said to be hurting business.

Navigation has opened on the Great Lakes, and iron ore is beginning to move. Conditions look better, though ore prices are not yet set. Birmingham continues active.

Underground employees of the United Comstock Mines Co., in Nevada, struck recently because of proposed changes in working conditions.

Six new radio-active minerals have been determined by Professor Schoep, of the University of Ghent, Belgium.

The Hollinger company has been sued by the Northern Canada Power Co. to prevent it from developing its own power.

The Schlesinger Estate interest in the Steel & Tube Co. of America has been sold.

Mining activity in the State of Durango, Mexico, is described by Alberto Terrones in this issue.

Reorganization of the Prince Consolidated Mining Co., at Pioche, Nev., is planned.

United Comstock Co.'s Employees Go on Strike

Demand $5 Flat Scale for Underground Work and Eight Hours Collar to Collar

Workmen employed underground by the United Comstock Mines Co., in the Virginia City district, Nevada, struck on April 18, demanding a flat wage scale of $5 per day for underground work and an eight-hour day from collar to collar. Previous to April 16 underground operations had been conducted on three eight-hour shifts, muckers being paid $4.50 and miners $5 per day. On April 16, the company notified the men that one shift would be discontinued, that the half hour for lunch would be on the men's time, and that wages would be unchanged.

About 80 per cent of the men are said to be out. The company reports that underground work is several weeks ahead of surface operations, and that the latter are progressing satisfactorily.

Elko Prince Co.'s Cyanide Mill Burned

Fire destroyed the fifty-ton cyanide mill of the Elko Prince Mining Co. at Midas Nev., early on the morning of April 11. An explosion of gasoline in the crank case of an oil engine which was being started is given as the cause. The mill was entirely destroyed, the other buildings being saved. Lee D. Dougan, resident superintendent for the Dorr Company, which manages and acts as consulting engineers for the Elko Prince, was in California at the time. Leslie L. Savage, president of the mining company, and Mr. Dougan are now at Didas.

Anaconda To Smelt Davis Daly's Ore, It Is Reported

By Telegraph to "Engineering and Mining Journal-Press."

Butte, Mont., April 24—It is unofficially reported that the Davis-Daly and Anaconda companies have concluded a contract for the treatment of the ore from the former's Colorado mine and that the mine will resume about May 1.

Butte & Superior May Settle With Minerals Separation

Conversations are understood to be under way between Minerals Separation, Ltd., and the Butte & Superior Mining Co., with the object of effecting a compromise in the accounting due.

Sues To Prevent Hollinger Developing Own Power

An attempt to block the Hollinger Consolidated Gold Mines, of Porcupine, Ont., from developing its own power on the Abitibi River has been launched by the Northern Canada Power Co. in an action entered by the last-named company for "specific performance," the performance being the signing of contracts alleged to have been agreed upon ten years ago, and which call for the supplying of "electrical energy for all the requirements of the mining company for the life of the mines." If this action is successful it will, in all probability, prevent the Hollinger from developing its own private power supply. Negotiations for that supply have been in progress for more than a year, and conferences have been held recently between Hollinger, the Abitibi Power & Paper Co., and the T. & N. O. Ry. Commission, but without resuts.

Coal Stocks Decreasing Fast as Strike Continues

Consumers Still Indifferent — Chances of National Meeting Between Miners and Operators Appear Slight

All of the initial tendencies of the coal strike were intensified further during its third week. The indifference of consumers was more marked. Unbilled coal on tracks reached a total of 1,500,000 tons on April 8, and at this writing had decreased but slightly. Coal continues to be consumed at the rate of 5,000,000 tons per week in excess of production. The country is approaching the end of its reserve at a more rapid rate than anyone had conceived to be possible. The draft on coal stocks is twice that predicted.

One of the disquieting features of the situation to the operators is the steady progress being made by representatives of the United Mine Workers in non-union territory of central Pennsylvania. The fear is expressed that the union may be able to annex this territory permanently. The additional mines which have closed in central Pennsylvania are more than offset by those which have opened in northern West Virginia, but the strategic value to the union is important.

Observers in Washington believe that if there had been any possibility of a national meeting between operators and mine workers it has been dissipated by the statement of the Attorney General. As he does not name the illegal things which he seems to believe have been taking place at former meetings, operators would probably be less inclined than ever to enter into a conference without a knowledge as to what would be regarded as illegal.

United Eastern Co. Equipping Mexican Property

In January, 1922, the United Eastern Mining Co., of Oatman, Ariz., took over a controlling interest in the El Tigre group of mining claims. They comprise sixty-three pertinencias and are situated in the municipality of Huajicori, district of Acaponeta, state of Nayarit. The property is about fifteen miles from Acaponeta, which place is situated on the line of the Southern Pacific of Mexico, about one hundred miles southeast of Mazatlan. It is practically a prospect, although the *gambosinos* have taken out a considerable amount of gold at various times. The agreement provides that the United Eastern shall complete the purchase price and provide funds for development and equipment. The funds advanced are to be repaid out of the first net profits from operation.

The final payment of the purchase price has been made, and machinery is now en route to the property for prosecuting the development, which is in charge of P. A. Wickham. This is a gold mine; as far as known, the ore contains no other metal. The vein is 5 to 8 ft. wide and averages about $20 per ton. Water and timber are abundant, and with present labor conditions it should be possible to operate economically and earn a substantial profit if the enterprise develops as anticipated.

Schlesinger Estate Interest in Steel & Tube Co. Sold

Announcement has been made of the sale to a syndicate of New York bankers of the interests of the Ferdinand Schlesinger estate in the Steel & Tube Co. of America, the Milwaukee Gas & Coke Co., the Newport Chemical Co., and other concerns. Ferdinand Schlesinger as principal owner of the Newport Mining Co. and the Anvil Mining Co. was active in developing the Newport and Anvil-Palms-Keweenaw mines. These later became the principal source of ore for the Steel & Tube Co. of America, which was formed a few years ago, and they are the largest underground iron mines in the Lake Superior district, if not in the world. It is understood that Armin A. Schlesinger, president of the Steel & Tube Co., will remain in active management, although the other heirs have sold their interests in the company.

Embargo on Quebec Asbestos Under Consideration

Efforts are being made by the Canadian Manufacturers' Association to have the Quebec government adopt legislation levying an excise tax or royalty on raw asbestos shipped to the United States. This step is being taken in retaliation for the proposal in the Fordney tariff bill to place a tariff on manufactured asbestos. Some talk of a possible embargo on raw asbestos is heard.

Newport and Anvil Iron Mines To Go on Full Time

By Telegraph to "Engineering and Mining Journal-Press."

Ironwood, Mich., April 24—Operations will be conducted on full time as soon as possible at the Newport and Anvil mines, on the Gogebic Range, by the Steel & Tube Co. of America. About 900 men will be employed. Announcement to this effect has just been made by R. P. Zinn, manager of the company.

Transvaal's Gold Output Small in First Quarter

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 21—The Transvaal Chamber of Mines advises that the total gold production in the Transvaal from January to March was 639,728 fine ounces.

Spanish Graphite Company Seeks Loan

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 22—A message from Madrid states that a Spanish company Minas de Grafito de Espana, has requested a loan of 500,000 pesetas for the purpose of developing its graphite mines more vigorously than it has been doing.

Tariff on Manganese Ores Urged by Colorado Assembly

Fourteen-Fold Increase in Production Since 1914 Cited as Reason for Protection

On April 20, the Colorado Assembly passed a joint resolution calling upon the state's representatives in Congress to exert their best efforts to secure a duty of 1c. per lb. on the manganese content in all imported ores.

The resolution referred to the increase in production of high-grade manganese ore in the United States from 2,635 tons in 1914 to 305,869 tons in 1918 and a total increase of both high and low-grade ores from 100,900 tons in 1914 to 1,474,674 tons in 1918, as evidence that the manganese reserves of this country are ample and sufficient to meet all industrial needs of the country.

As worded, the resolution protesting against the placing of Colorado miners in competition with the cheap labor of China, India and Brazil reads as follows:

"Resolved: That in order to add to the revenues of the nation, to furnish adequate business to the railroads of the West, to stimulate Western mining production, and particularly that the manganese ores of the State of Colorado can be mined and furnish employment for the miners of the West, the Senators of the State of Colorado are hereby earnestly urged to exert their best effort to secure the adoption by the United States Senate of the tariff rates proposed in the Fordney Bill for the protection of the manganese industry of the West."

Six New Radio-active Minerals Determined

Occur in Specimens of Uranium Ores Found in Belgian Congo—Discovered by Professor Scheep, of Ghent

Six new uranium minerals, all of them radio-active, have been determined by Prof. Alfred Schoep, of the University of Ghent, Belgium, in specimens of ores from Kasolo, Katanga, Belgian Congo, about 30 km. south of Kambove. Preliminary notes relating to the properties of four of them have already been communicated to the Académie des Sciences, Paris. They are:

Curite, named after P. Curie, $2PbO.5UO_3.4H_2O$.

Kasolite, named after Kasolo, the place of origin, $3PbO.3UO_3.3SiO_2.4H_2O$.

Dewindtite, named after Dr. Jean De Windt, a young Belgian geologist, who died in the Congo, $4PbO.8UO_3.3P_2O_5.12H_2O$.

Stasite, named after J. S. Stas, the Belgian chemist; it has the same formula as dewindtite but is of a different class of symmetry.

The fifth and sixth minerals are, respectively, an hydrous silicate of uranium and an hydroxide of uranium. The notes on these are to be read at the Academie, in Paris, in a few weeks.

Professor Schoep prospected in the Belgian Congo for two years prior to 1913 without finding anything of special interest. But in April, 1920, he bought of Butler Brompton, in London, the specimens from Kasolo above noted.

Against Colorado & Southern's Proposal To Abandon Branch

The special examiner for the Interstate Commerce Commission who held a hearing in Denver, Col., on Feb. 2, 1922, upon the application of the Colorado & Southern R.R. for permission to abandon a twenty-nine-mile branch line extending from Buena Vista to Romley, Col., has recommended to the commission that the petition be denied.

The examiner reported that prospects for increased traffic are fairly good, and that the protests of municipalities and mining companies along the line made a sufficient showing that the operation of the road was necessary for the public convenience. The report stated that the revival of mining in the district should be sufficiently profitable to justify continuance of service.

For Lower Potash Tariff

Senator Dial, of South Carolina, has introduced an amendment to the Tariff bill decreasing the duties on potash from those carried in the bill as reported to the Senate by the Finance Committee. He proposes that the duty during the first two years of the new tariff shall be 1c. per lb., instead of 2½c. per lb.; during the third year ¾c. per lb., instead of 2c.; ½c. per lb. for the fourth year, instead of 1½c. per lb., and ¼c. per lb. instead of 1c. per lb. during the fifth year. Thereafter he proposes the duty shall be removed, as is also proposed by the committee.

News from Washington

By PAUL WOOTON
Special Correspondent

Foreign Valuation Favored in Senate

Bill Said To Be So Framed as to Prevent Loss of Markets and Yet Permit Competition from Abroad

Initial discussion of the tariff bill in the Senate reveals that there is practical unanimity of opinion in that body that the ad valorem rates in the bill should be based on a valuation made in the country of origin. Sentiment in the Senate seems to be as strongly opposed to American valuation as that of the House is in favor of it. Approximately 60 per cent of the commodities covered by the dutiable list take ad valorem rates. The remainder of the articles on the dutiable list are covered by specific rates. Every effort was made by the Finance Committee to apply specific rates wherever possible. The difficulty is that specific rates are impracticable in many instances.

Many in the Senate are in favor of passing over American valuation without dignifying it by discussing the plan in the Senate. It seems probable, however, that it will be necessary to debate the whole subject, as the bill reported to the Senate provides for the application of American valuation if the President should deem it necessary.

Chairman McCumber of the Senate Finance Committee agrees that of all times in our history this is the very worst to formulate and put into effect a new traiff measure, but at the same time he declares there never has been a time when it is more necessary to protect American industry against abnormal situations abroad which give special advantage to the foreign producer. He points out that wages in Germany declined enormously immediately following the Armistice. In the other countries, he said, measured by the only stable currency in the world, the American dollar, the spread between American cost of production and foreign cost of production has been growing greater and greater. On the other hand, costs of production increased in this country until January, 1921.

In the bill which the Finance Committee has reported, Senator McCumber believes there is no rate so low that it will compel the American producer to surrender the American market to the foreign producer, if he exercises proper economy in the manufacture and marketing of his product. On the other hand, he believes, no rate is so high as to prevent reasonable foreign competition.

In Senator McCumber's opinion, the recognition in this bill of greater degree of protection for the agricultural industry will mean a great deal toward stimulating business, in that the prosperity of the farmer is radiated to all other activities. In discussing the bill in the Senate, he took occasion to rap the "back-to-the-farm" movement.

"We already are producing such a surplus of farm products," he said, "that our prices are low, yet many are preaching a policy of inducing more people to go into the farming business, thereby decreasing the number of consumers and increasing the number of producers. What a fallacy. What a short-sighted theory. What the farmer needs is the greatest number of consumers of his product. If he can make home production, even though the deficit the home consumption greater than the does not exceed 1 per cent, with the proper tariff wall, he can secure a just price for his product."

Comparisons between the present bill and the Underwood act or the Payne-Aldrich law are of little value, in the opinion of Senator McCumber. He declares his committee gave but casual attention to either of these acts. The whole industrial, commercial, and economic world has changed since those bills were enacted, he contends.

Under the bill as amended by the Finance Committee, Senator McCumber expects to see the Tariff Commission become a forum in which any complaints may be lodged as to the unfairness or the injustice of any rate. With the powers given the President, it will be possible to rectify any injustice that may be worked by reason of rapidly changing conditions.

Senator McCumber contends that two-thirds of the bread-winners in the United States have an income not greater than that which they received before the war. In many cases they are receiving less than their pre-war income. This takes into consideration the increased amounts which are being paid for rents and taxes. As nine-tenths of all American products are sold at home, he urges on manufacturers the necessity "of bringing down the production cost of their commodities until they are within the purchasng reach of American farmers and American wage-earners—a reach that cannot extend one inch beyond the limit of their earnings." He suggests that manufacturers be satisfied with the most meager returns upon their investment for a while. At the same time he urges employees to increase their efficiency to the highest possible degree. He says efficiency is being increased, but that it has not yet reached its pre-war standard. He also urges the retailer to cut his profits to the bone so as to add his contribution to the return to prosperity.

The tariff bill as reframed in the Senate is expected to yield $350,000,000 annually.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended April 22 amounted to 103,700 fine ounces. This brings the total purchases under the Pittman Act to 103,380,308 oz.

I. C. C.'s Failure To Pass on Rates Hurting Business

Increasing Pressure Expected to Speed Up Decision—Only Four Members Have Heard Case

It has been called forcibly to the attention of the Interstate Commerce Commission that the delay in handing down a decision in the freight rate reduction case is having a serious bearing on the business situaton. It is believed that the commission has been doing all within its power to expedite the consideration for this case, and the gradually increasing pressure for an early decision is expected to accelerate the straightening out of the snarl in which the commission finds itself. There are eleven members of the commission, but only four of these heard all of the case. The leadership in the diverging opinions within the commission is thought to come from this group of four. Regardless of the pressure which is being exerted, the importance of the case is such that each commissioner is being especially careful of his ground.

Preparing for Hearings on Mine Law Revision

Final arrangements were completed early last week for the extended hearings before the Committee on Mines and Mining of the House of Representatives at which revision of the mining law will be discussed. W. R. Ingalls, the chairman of the committee that drafted the revision of laws bill which now is before the committee, was scheduled to be the first witness. He probably will be followed by Horace V. Winchell, a member of the Ingalls committee.

Shasta County Takes Appeal in Assessment Case

The County of Shasta, Cal., has appealed to the Supreme Court to reverse the decisions of the Northern District of California Court and the Circuit Court of Appeals, Ninth Circuit, which reversed valuations of the mines of the Mountain Copper Co., and the Balaklala Consolidated Copper Co. The county contends that the valuation assessment of the properties by the county authorities was proper and that the decision of the lower courts that their assessments were excessive was based on conjecture and not evidence. The county assessor valued the Mountain Copper Co. mines at $125,000, which was increased to $549,000 by the Board of Supervisors, taking as a basis 30 per cent of the gross value of the proved ores, estimated at $1,830,440. The Balaklala company's mines were assessed by the county assessor at a valuation of $180,000 which was increased by the Board of Supervisors to $327,700, also based on 30 per cent of the gross ore value.

News by Mining Districts

London Letter

Burma Corporation Shareholders Want More Information—Tharsis Passes Dividend—Wit. Deep's Report Notable

BY W. A. DOMAN

London, April 11—An occasional grumble is heard that the head office of the Burma Corporation has been transferred from London to Rangoon. A large amount of capital has been sunk in this great undertaking, for the shares touched £14 at one time, and although there seemed good reasons for having the management on the spot, so to speak, shareholders have a feeling that they are cut off from information. To a certain extent the directors are filling the gap by the issue of quarterly reports, the first of which appeared a few days ago. This report, for the three months to Dec. 31, is interesting up to a point, but its usefulness could be increased. Shareholders receive financial details, but the technically inclined man is always keen on learning something of ore values. Possibly when the report for the first quarter of the current year makes its appearance an improvement may be shown. For the December period the estimated gross revenue was £404,600, and the estimated operating expenditure £253,733, giving a surplus of £150,867. From this must be deducted debenture interest, estimated income tax, depreciation, and capital expenditure, amounting to £97,733, leaving a balance of £53,134.

A determined effort is now being made to get the Bwana M'Kubwa on its feet. For years there has been more promise than performance, due, of course, to the refractory nature of the ore. Minerals Separation, Ltd., have come to the rescue with a new process for treatment, and they have been appointed consulting metallurgists to the new company. Above the 450 level there is a large body of oxidized and mixed oxide-sulphide copper ore, and with low-cost open-cut mining methods, profitable operations at an early date are expected. What is meant by an early date is not quite clear, for "it is intended to proceed as rapidly as sound engineering will permit to elaborate plans for the working of the oxidized portion of the mine and the construction of a plant to treat these ores by the new process, probably on a basis of not less than 1,000 tons per day." Simultaneously, the sulphide ore is to be opened up below the 450 level. The reorganized capital is £400,000, in 5s. shares, the new shares carrying an assessment of 2s. 6d. per share, payable in instalments of 6d.

It is certainly an event for the Tharsis Sulphur & Copper Co. (in Spain) to pass its dividend. In the course of its long existence—it was established at the end of 1866—the company has distributed approximately £11,000,000 to its shareholders. For last year, owing to the small world demand for pyrites, on account of the great depression in trade, no dividend is to be paid. The ore raised from the Tharsis and Calañas mines was 260,758 tons, as compared with 313,918 tons in 1920, a decrease of 53,160 tons, though the mines can supply any quantity of pyrites for which a demand arises. The actual net profit was only £45,945, in contrast with £134,949 in 1920. The value of the mines in Spain, originally about £785,000, has been written down to £43,512, and the works, buildings, machinery, and plant, which cost £1,336,772, are written down to £272,207. The stock in trade amounts to £1,039,605, and the company has securities and cash totaling £342,485.

Whatever criticism may be leveled against the directors of the Witwatersrand Deep, who captured the company from the Central Mining Corporation, it cannot be said that they are niggardly with information as to the condition of the mine. In one sense they give a greater wealth of detail than many other and more important companies, and it is in this detail that the weakness of the position is revealed. The total revenue last year was £610,981, and the total working costs were £526,093, leaving a working profit of £84,888. It is shown, however, that of the revenue £133,077 was contributed by gold premiums, so that, apart from the premiums, there would have been an actual loss. During the current year to date, gold has fetched a lower price than last year, so that unless working costs can be substantially reduced, the profit will not be so large. One gathers, too, that large capital expenditure will be necessary in the near future at the cyanide works and boiler plant at the east shaft.

PHILIPPINE ISLANDS

Benguet Consolidated Mining Co. Shows Improvement

Antamok—In 1921, the Benguet Consolidated Mining Co. treated 40,941 tons of ore, averaging $16.585 per ton, with a recovery in gold and silver bullion of $600,997.05, or $14.68 per ton, equivalent to 88.5 per cent of the contents. Gross receipts were $622,036.86, operating expenditures $259,906.03, leaving $362,130.83 gross profit, or practically $8.85 per ton. Net profit, after writing off $62,559.89 for development and depreciation and after paying $11,982.83 in bonuses, was $287,588.11 or practically $7.05 per ton. Of this profit, $149,363.38 was spent for extensions to plant and for development and exploration. Capital distribution of $150,000 was made to stockholders. Results in 1921 showed an improvement, especially in cost of mining. Development work yielded a considerable tonnage for the mill. Supplies cost less and labor conditions were better. A slight falling off in recovery is explained as due to crowding the mill. Additions are to be made this year to remedy this. Good ore apparently continues with depth, and the company's finances are in excellent condition. Conditions are now stable.

MEXICO

Durango

Situation Quiet; Prospectors Unmolested—Activity in Santiago Papasquiaro, Cuenacame and Other Districts

BY ALBERTO TERRONES BENITEZ

Durango—In general, the situation in the State of Durango is quiet. Prospectors and engineers of all nationalities go about unmolested. The bandits have disappeared. The state government is doing its best to facilitate mining exploration.

Santiago Papasquiaro District—The Bacis Gold & Silver Mining Co., Ltd., has been operating uninterruptedly its mines and mill at Bacis. W. R. Bewder is superintendent. Large quantities of milling ore have been treated at the concentrating-cyaniding plant. On an average the company is exporting thirty-five bars of bullion monthly, through Juan Leautaud's firm, of Durango City, the only firm doing banking business in Durango for all important mining companies. As soon as the mill capacity is increased, this production will be increased to forty-five or fifty bars of bullion per month.

The Sauces Mines & Milling Co. is still operating at Sauces, near the Tepehuanes railway terminal. L. H. Siegler is the manager. The company is shipping ores to the Asarco smelter of the American Smelting & Refining Company.

The Santa Cruz Mining Co., operating the Santa Cruz y Anexas mines, near Otaez, has just finished its new 25-ton concentration-flotation mill, originally designed by the Mine & Smelter Supply Co. S. W. Loving, general manager, has recently gone to the mine to take charge of operations. The principal offices of this company are at Beeville, Tex.

George Stinson has been in San Andres de la Sierra, his purpose being to erect a modern smelter in place of the old one. Lead-silver ores are abundant in this camp.

Lino Rodriguez e Hijos have decided to sell their Prieta mine at the Huajupa camp. A party of American engineers went to examine the property.

Max Damm has personally taken charge of operations at the Promontorio mine. This company has recently been treating the dumps and the mill ores extracted from the upper levels (above the water level) using the mill, which has been adapted for flotation. Ores and concentrates are being shipped to Asarco.

Durango District—Open-cut operations at the Cerro de Mercado have been continued under the direction of Manuel Rangel. Ore is being shipped to the Monterrey smelter of the Cía. Fundidora de Fierro y Acero de Monterrey, owner of the part of the Iron Mountain that is being exploited. The operator's have just partly suspended work on account of the large tonnage

of ore on hand, as they have extracted more than they can ship.

A prospector by the name of Hosmer has recently been studying the Coneto and the Potrillos camps. The former produces lead silver ores and the latter is in the stream-tin country. These camps are now abandoned and should be important places for exploration. The bandits have now disappeared.

The Avino Mines Ltd., which owns mines at Avino, has been working recently on a small scale and is shipping ores to Asarco. Its mill is being rebuilt. Gerald E. Norton is in charge.

Dr. T. E. Moore, Joseph B. Crawford, George D. Wolfe, Howard Foster, and "Billy" Brown, recently went to the Pueblo Nuevo country to check up some mining properties near Pueblo Nuevo for a Texas syndicate. Dr. Moore and Mr. Crawford have since returned to Fort Worth, the rest of the party remaining in Pueblo Nuevo to finish the examination.

The Guadalupe Mining Co., operating in Pueblo Nuevo and owner of the Guadalupe mine, is getting ready to start work. The La Cruz-Providencia Mining Co. has also begun the extraction of small quantities of high-grade ores. It is rebuilding its mill, at which the ratio of concentration is 20 to 1. Ore below 5 kg. silver per ton is mill ore; the rest is shipped direct. Freighting is done on mule-back to El Salto, the nearest railway station on the Durango-Mazatlán line, at the rate of 70 pesos per ton. Gerald E. Norton is president of both companies.

Nombre de Dios District—The Parrilla camp, where the Vacas Mining & Exploration Co. worked for so many years, still remains idle. Negotiations have been recently started to revive this camp. The company is represented by F. MacCaughan.

Enrique Nájera has acquired a large extent of mining claims at the Sacrificio Mountain and plans to erect a smelter for the Sacrificio ores.

Mapimi and Lerdo Districts—For reasons of economy the Cía. Minera de Peñoles decided to move its Peñoles smelter to Torreón. It is working its mines at Ojuela. Heath Steele is general manager.

J. W. Deland, manager of the Pasadena Oil Crown Co., has started negotiations to lease some oil lands in the Lerdo district. Explorations for oil have been already started under the direction of Roy A. Reynolds, and traces of oil have been found at a place called Goma, near San Carlos Station. The exploration work is still going on.

Cuencamé District—Senator Severino Ceniceros has resumed work at his smelter near Cuencamé. He has been smelting ore from the Pozuelos lead-silver mines.

The Asarco smelter and the Velardeña mill and mines of the American Smelting & Refining Co. have again resumed. At Asarco they have blown in two furnaces. As the ores produced in the camps tributary to the Asarco smelter have been scarce, the smelter could not run at capacity.

Chihuahua

Erupcion Mining Co.'s Ore Deposit Interesting

The properties of the Erupcion Mining Co. and the Ahumada Lead Co. are situated in Los Lamentos mountains, about forty miles east of Villa Ahumada. The values consist of lead carbonates carrying silver; also, zinc carbonates which are formed in separate bodies and carry neither lead nor silver. The peculiarity of this deposit is that it averages much higher in lead than any other similar large deposit in this section of the country. The ore follows the bedding planes in limestone which has an average dip of about 17 deg. The main extraction and development tunnel has a length of 2,200 ft.

Development done in 1921 totaled 5,039 ft. The Marjorie, or main extraction tunnel was completed last year to the property line, a distance of 2,235 ft. At this point a winze was started, and after a cave was broken into at 156 ft. the ore was found at the bottom. The cave extends 84 ft. north of the Erupcion line and about 50 ft. back into the company property. The ore disclosed is an high-grade anglesite. The winze was sunk to 204 ft. following a pipe of low-grade iron ore and a small *manta* 5 ft. thick was discovered. This appeared to have its own cave system. The ore was somewhat different from the Erupcion, being mixed with high-grade lead carbonate and running higher in silver. Further development was impossible owing to the mine closing down.

A broad-gage railroad is being built to connect this property with the Mexican National line at Lucero, a total distance of forty-eight miles. The grading has been completed and the company expects to complete the construction within the next few months and to be shipping ore by early fall. The road is being built jointly by the Erupcion and Ahumada companies.

CANADA

Ontario

Conditions in April—Kerr Lake to Start Work on Goldale Property

Conditions at Sudbury remain practically unchanged, but prospects for resumption of operations look brighter. The British America Nickel Corporation has allowed practically all remaining members of its staff to go.

At Cobalt, the production in April was somewhat lower on account of the closing down of the Bailey and Silver Cliff properties and the interruptions due to floods. The spring freshets were exceptionally severe, and the Princess mine was completely flooded; the Kendall shaft of the Nipissing was partly flooded, and the O'Brien mill forced to close. Nipissing and La Rose paid dividends. O'Brien bought Bonsall property in Gowganda.

Kirkland's output continues to increase, the Tough-Oakes mill being started. Rich ore was found on the lower levels of the Wright-Hargraves. The amalgamation of the Ontario and Montreal Kirkland was completed.

Porcupine should show slight increase on account of increased power available. The recent floods will provide plenty of power for present demands.

Labor is still plentiful and efficient, with fewer men unemployed.

Cobalt—Nipissing has stopped work once more on the Rochester property at Porcupine, supposedly while assaying catches up with diamond drilling. The company's option on this property expires in June, but no official announcement has been made as to the management's attitude in this connection.

The gross earnings of the Bailey custom mill for March were approximately $14,936.52. The mill treated 4,978 tons of ore, the Bailey mine supplying 650 tons.

According to a statement by F. L. Culver, at the annual meeting of the Beaver Mines, the present low price of silver, labor conditions, and the slump in the demand of silver do not warrant the reopening of the Beaver mine at present. He stated, however, that as soon as the price of silver was such that operations could be carried on with a fair profit, the mine would be reopened.

Developments at the Castle-Trethewey, at Gowganda, continue satisfactory. The high-grade is running up to 3 in. wide of 3,000 to 4,000-oz. ore. There is a possibility that this is an entirely new strike, but the management is assuming that it is the downward extension of the rich vein cut in the shaft at the 185 level.

The shaft at the Victory Silver Mines is down a little over 400 ft. and will be continued another 50 or 75 ft. before a station is cut and a new level opened up, which will be in the course of about a month.

Two veins were cut on the Silverado property, adjoining the Hudson Bay property at Gowganda, while driving to the No. 1 vein on the 200 level, the first vein showing a width of 4 in. and the second vein a width of 7 in. The property has a crew of about twenty-five men working, and two drills are in operation.

Kirkland—The annual report of the Kirkland Gold states that although the mill was not run at capacity, owing to the fact that so much ore was tied up on account of the possible rock slide, 25,717 tons of ore was treated, giving a production of $147,654.83 in gold bullion for the year.

At a meeting of the Hunton Kirkland shareholders, held April 19, the merger of the Hunton and Minaker Kirkland companies was ratified.

Porcupine—Work is to be started at once by Kerr Lake on the Goldale property, lying south of the Plenaurum property. This is one of the groups totaling fifty claims that the Kerr Lake company has under option in the Porcupine district. No other development or exploration work will be carried on by the company in this district until summer.

Schreiber—Much attention has lately been directed to the gold deposits adjacent to the town of Schreiber, in the Port Arthur district, since options were taken by Toronto interests on the Harkness-Jackson and McKillar-Longworth properties, which are stated to have shown up well as far as developed. A large number of prospectors have gone in, and much staking is being done.

Ottawa—The Canadian government, in anticipation of a rush of gold and oil prospectors early in the season, is preparing for extensive surveys in the Northwest. A survey party, including B. H. Segree, A. H. Miller, and A. H. Swinburn, is leaving Edmonton for the Mackenzie River district. One of the most important objects in view is the locating of a point on the sixtieth parallel where it crosses the Liard River from which other lines can be run so that if a strike of gold is made on the Liard and tributary streams it can be determined whether the claims lie in British Columbia, the Yukon, or the Mackenzie River district, as all three converge at this point. A number of surveys will also be made in the Great Slave Lake area.

British Columbia

Increase of Cork-Province Capitalization Proposed—Hedley Gold Resumes

Rossland—Possibility of a coke shortage in the future as a result of the coal strike in the Crow's Nest Pass region is reflected in some curtailment of local operations of Consolidated Mining & Smelting Co. Some of the men laid off have found employment with the company at Kimberley and Trail.

Hope for a solution of the transportation problem affecting the Velvet mine is held forth in the possibility that lumbering interests may arrange with the Great Northern Ry. to operate on their own account the abandoned Red Mountain line, between Rossland and Northport.

Kaslo—Legal details in connection with a plan for refinancing the Cork-Province Mines, owning a silver-lead property on the South Fork of Kaslo Creek, are being worked out. It is planned to increase the capitalization of the company from 1,250.000 shares to 1,500,000, and bonds will be issued in the amount of $75,000. A part of the bond issue will go to creditors of the company, retiring indebtedness, and the remainder will provide the capital required for development needed to place the mine in a position to produce a regular tonnage.

Trail—Ore received by the Trail smelter of the Consolidated Mining & Smelting Co. from April 8 to April 14 totaled 8.089 tons, of which 7,927 tons came from the company's mines. The No. 1 mine at Ainsworth shipped 78 tons and the Silversmith at Sandon 84.

Hedley—Work has been resumed at the Nickel Plate mine by the Hedley Gold Mining Co.

ARIZONA

Arizona & Swansea Plea Denied—C. & A. Board Re-elected—Shannon Co. Abandons Yaeger Canyon Mine

BY JAMES H. MCCLINTOCK

Phoenix — United States Judge Maurice Dooling, at Tuscon, has signed a judgment that gives Hoval A. Smith only $145,775.01 from Henry B. Hovland, something less than $900,000 under the findings of E. F. Jones, master. Exception was taken to the decree by both parties. The decision commands that all the business of the Smith-Hovland partnership be wound up at once, and the court retains jurisdiction until this has been accomplished.

Charges against M. T. Frasier and George Mitchell in connection with the affairs of the Jerome Superior Copper Co. have been dismissed.

The Arizona Corporation Commission has denied the application of the Arizona & Swansea R.R. Co. for permission to abandon and dismantle its twenty-one-mile road from Bouse to Swansea, in northern Yuma County, Ariz. The only prospective patron is the Swansea Lease, which is preparing to ship ore to Humboldt. The railroad is delinquent for $5,745 taxes, for which the state has entered suit in Yuma.

In Mohave County, executions have been taken against the Midway-Moss Mining Co., the McCracken Silver Lead Mining Co., and the Nevada-Arizona Mines Co., with sheriff's sales advertised.

Globe—Only one furnace of the Old Dominion smelter is to be operated for the present, according to W. G. McBride, general manager. A few additional men have been employed, the smelter being worked mainly by men transferred from other departments. Production will be about 800,000 lb. per month.

The new stack of the Inspiration power house, erected eighteen months ago, has been put into use.

Superior & Boston, in developing the Rigby vein, has drifted 500 ft. on the 400 level. For the last 80 ft. the ore has averaged 10 per cent copper and 23 oz. silver, for the drift width of 4 ft. The same vein is being opened on the 600 level. Rich small lenses occasionally are struck.

Bisbee—At the annual meeting of the Calumet & Arizona Mining Co., the old board was re-elected; also the old board of the New Cornelia. It is denied that the company has abandoned hope of finding ore in the Gadsden property in the Jerome district. Thus far no decision has been reached as to the inclusion of the Shea property in the C. & A. development work at Jerome.

Ore production is increasing, as high as sixty-eight carloads a day being sent to the Douglas smelters.

Hayden—Smelting is to be resumed at Hayden about May 1, and the copper stack of the El Paso smelter is to be blown in at the same time. Most of the work of the Hayden plant is in handling Ray concentrates.

Prescott—The Yaeger Canyon mine, between Prescott and Jerome, has been abandoned. The pumps have been pulled, and the mechanical equipment is being sold. For about six years the property has been under development by the Shannon Copper Co., it being one of the two Arizona mines retained by that corporation. A. L. Ferris, who has been in charge, will go to new work in Mexico, for the Shannon interests.

NEVADA

Rochester Silver's Reserves Increasing —Simon Mine's Orebody Found on 450 Level

From Our Special Correspondent

Rochester—The March output of the Rochester Silver Corporation was 5,033 tons of ore, with a gross yield of $50,000. Mine conditions are said to be excellent, with ore reserves growing. On the 250 level south the south drift on the Springer vein is in ore of good grade, with virgin territory below and for 250 ft. to the south. An old tunnel, 50 ft. lower than the 250 level, is being advanced and should cut the vein within 60 ft.

Mina—The main orebody in the Simon Silver-Lead mine has been found on the 450 intermediate level. The ore is stated to be 12 ft. wide, 8 ft. being above milling grade and 4 ft. high grade.

Tonopah—The Tonopah Belmont Development Co. has taken over a part of the Buckeye Belmont ground on lease and option, and is repairing the 1,200-ft. vertical shaft of the latter company preparatory to starting underground work. The Buckeye property is well situated, being bounded by the Halifax on the north and the Belmont and Rescue on the west and northwest, but no commercial ore has ever been discovered in its ground. Limited development work has been done on the 900 and 1,200 levels, but the property has been closed down for several years, owing to lack of money. It is reported that the ore recently discovered on the 1,200 level of the Midway mine continues to show commercial values in the drifts, although not so high as at first reported.

Divide—Tonopah Divide's March production was 1,841 tons, average value being $35.19 per ton. Net returns, after deducting losses and milling costs, were $47,000. This is a record monthly production for the company. The Gold Zone is developing a promising orebody above the 600 level and has started shipments to the Belmont mill at Tonopah.

Pioche—The property of the Home-Run Copper Co. was purchased last week by the Bristol Silver Mines Co. for cash. The claims adjoin the Bristol and have produced a large tonnage.

The directors of the Prince Consolidated plan to reorganize in Utah, making the stock assessable, and later to levy an assessment of 10c. per share. With these funds, the mine will be further equipped and developed. Indebtedness approximately totals $43,000.

CALIFORNIA

W. J. Loring Takes Bond on M. C. Meeker Claims—Hydraulic Mining Active in North

San Francisco Correspondence

San Francisco—The bonding of a new group of mining claims between the Carson Hill group and Melones and Angels Camp by W. J. Loring is of considerable interest to Mother Lode miners. The claims are owned by the heirs of M. C. Meeker. Their acquisition by Loring gives him in a single unit a length of the Mother Lode variously estimated at about seven miles. The bond is a working bond to run for three years and allows considerable discretion to Mr. Loring in the amount and distribution of the work. The stipulated price, if the bond is exercised, is $400,000. Little work has been done on the group.

Northern California, particularly in Siskiyou County, is active in hydraulic mining which centers at Cecilville, Oak Bar, Forks of Salmon, Sawyers Bar, Scotts Bar, and Fort Jones. At Cecilville, the Jefferson Consolidated, Conzetti, and other properties are in operation. The Shasta Dredging Co. has taken over its option on the Van Matre ranch, near Minersville.

At Grass Valley, a bond on the Spring Hill property, near the Idaho Maryland, has been secured by Harry James. The claim adjoins the Golden Gate. It is planned to explore the property through the Golden Gate.

The Pittsburgh Syndicate is developing a gravel mine at Iowa Hill, Placer County.

The Elephant Deep mine, near Jackson, is operating three hydraulic giants and washing practically 2,000 cu.yd. of gravel per day.

The Vanderbilt mine, in the New York mining district, San Bernardino County, has been sold to a Los Angeles syndicate and is to be reopened.

OREGON

Huntington—Sampling of a car of crude ore shipped from the Bay Horse mine to Salt Lake City gave gross returns of $2,500 for 96,686 lb. The property is now in condition for regular production of crude ore on a considerable scale. The directors recently decided upon a plan of development, which in the main will consist of a further driving of the main tunnel on the orebody. Camp accommodations are to be enlarged and the working force is to be increased.

Baker—The mill at the Imperial mine, in Cable Cove, has resumed operations, after being shut down for a short time.

Eugene—The Oregon & Ohio Mining Co., in which Cleveland, Ohio, capital is interested, has purchased about twenty claims in the Bohemia district. It is reported that considerable money will be spent. Hugh M. Henton, of Cleveland, is to be put in charge of development work.

IDAHO

Sandpoint—The Falls Creek Mining Co. plans to resume development early in May.

Cabinet—The Carpie Mining Co. will resume development of its copper property near Cabinet, and continue shaft sinking to at least 500 ft.

Hope—The Bonner Mining Co. has resumed work on the Marguerite, up Trestle Creek.

The King Solomon's Mines Co., a reorganization of the old Rebecca Mining Co., maintained development all last winter. Some stringers showing gold and silver ore have been cut.

UTAH

Several Companies Ready to Ship to Tooele—Ores from Alta Soon—Vipont Mining Co. Active

From Our Special Correspondent

Tooele—Preparations for the resumption of operation at the International smelter, which is expected to start up about July 1, are being completed. Ores are now received from a number of Tintic and Pioche properties. Milling has been resumed at the Ophir Hill, which will furnish lead concentrates. Ores from the Utah Consolidated, at Bingham, which, shortly before its closing down, completed a 1,000-ton flotation mill, are expected when the smelter starts. At present eighty men are employed on repairs and when the furnaces are blown in 450 men will be put to work.

Marysvale—The Bully Boy property, covering 120 acres and situated about six miles southwest of Marysvale, is reported to have been acquired by Pittsburgh men, and there is talk of a 100-ton mill being built.

Oakley (Idaho)—The Vipont Silver Mining Co., which owns a mine and mill in Box Elder County, Utah, near the Idaho line, and ships its concentrates to Oakley, Idaho, over a twenty-six mile wagon road, is driving an operating tunnel and at the same time continuing mining and milling. The tunnel is being driven to reach the ore at depth and to afford more economical mining. It is now in 1,300 ft. and when a length of 2,000 ft. has been attained it will be turned to the north and connected by approximately 200 ft. of drifting and crosscutting with the inclined shaft from the upper workings, which is now producing about 100 tons of ore daily. This shaft bottoms 350 ft. below the so-called "A" workings. and is expected to connect with the tunnel at 745 ft. The present depth on the vein is 1,350 ft.. and the silver content is increasing with depth.

Park City—Shipments for the week ended April 14 amounted to 2,158 tons, as compared with 2,179 tons the week preceding. Shippers were: Judge Allied Companies, 982 tons; Silver King Coalition, 676; Ontario 495.

Alta—The mines of this camp, which was cut off during the winter, are preparing for the shipping season.

COLORADO

Leadville More Active — Tonopah Placers Dredge Ready Soon — Bonanza in Spencer Mine at Caribou

From Our Special Correspondent

Carbondale—A large force has been put to work on the Crystal River railroad, getting the track in condition for traffic. The road extends from Carbondale to the town of Marble, where the old Yule marble quarry is situated. For two years or more the quarry has been idle, and, save for a watchman, the little town of over 1,000 workmen was abandoned. Several hundred cars of marble are ready for shipment.

Leadville—Mining activity continues to increase. John Cortellini, manager of the Garbut, announces that on May 1 operations will be resumed at the mine, giving employment to about twenty-five men. When work ceased, about one year ago, the mine was producing approximately a car of ore daily. The Louisville mine, after four years of inactivity, will resume this month. Operations have been resumed by leasers on the old Tabor property, and an increasing number of leasers are employed on the Ibex. A promising strike of lead-silver ore has been made on the Lydia mine, in Iowa Gulch, where the ore is accumulating awaiting the opening of the roads.

Breckenridge — Repairs on dredge No. 1 of the Tonopah Placers Co., which was disabled early in February. are nearing completion, and it is expected that the dredge will begin operating early in May. The dredge of the Blue River Gold Dredging Co., which is operating in the main valley of the Blue, has continued shipments of bullion throughout the winter.

Boulder—A bonanza strike of ore is reported in the old Spencer mine at Caribou. A large body of ore which assays from 200 to 500 oz. in silver has been broken into from a crosscut from the old Caribou mine, and drifting is being pushed with all speed to ascertain the extent of the oreshoot.

Georgetown—The Neshota mill has been remodeled by the East Butte Copper Co., and is now in operation with three shifts on a twenty-four-hour schedule. Seven men are employed on each shift in the mill. Considerable underground development work is in progress at the mine, and the crew of miners has been increased.

The Sunburst Mining Co. is installing a fifty-ton Ruth flotation plant to treat ore from the Sunburst property and custom ores from adjacent mines.

Cripple Creek—The Roanna property is being developed by L. F. LeBrun and associates through the Atlanta shaft, which is 360 ft. deep.

In the South Burns mine, a station is being cut between the fourth and seventh levels, preparatory to development work at this horizon which was not opened by former operators. The Shurtloff vein is the first objective of the new development.

MICHIGAN

The Copper Country

Rail Movement of Copper Heavy—C. & H. Reclamation Plant Running—Repairing Conglomerate Shafts

BY M. W. YOUNGS

Houghton—Large sales of copper are being made by Lake producers. The present rail movement of metal, in fact, is the heaviest in two years and compares favorably with the movement by boat last year. During the first half of April, Calumet & Hecla shipped approximately 3,000,000 lb. of metal. Copper Range shipments also have been large, copper on the docks awaiting shipment by water having been sent forward by rail to satisfy the demand. The biggest month Copper Range has had for several years was February, when 5,000,000 lb. was shipped. March sales also were heavy, and Copper Range at present has comparatively little metal on hand—not more than a two months' supply.

The Champion mine of the Copper Range Consolidated Company has lost some men to the Calumet & Hecla—former employees of the latter company—and to the farms, as is usual in the spring of the year, but not a sufficient number to cut into production seriously Trimountain and Baltic have held their own in man-power. Champion is now producing at the rate of 58,000 tons of "rock" per month; Trimountain, 14,000 tons; and Baltic, 17,000 tons. This is a slight loss for the Champion and a slight increase for the Baltic. Trimountain's production has been unchanged for several months. Present production for the three properties is approximately 3,250,000 lb. of refined copper per month.

Calumet & Hecla's reclamation plant on the conglomerate sands at Lake Linden is again in operation.

Marquette Range

Navigation on Lakes Opened—Ore Prices Not Set—Freight Rate Decision Awaited—Outlook Better

BY WILLIAM H. NEWETT

Ishpeming—Navigation has opened on the Great Lakes for the 1922 season, and ore carriers are now arriving at Lake Superior and Lake Michigan ports for ore. The movement of ore will be light for the time being because the season's prices have not as yet been determined and will not be announced until after the Interstate Commerce Commission hands down decisions on several rail cases now pending. The shippers have asked for lower rates from the mines to the docks, and the question of rates from lower Lake ports to Eastern furnaces has yet to be decided, although the latter case has no bearing on the ore price. It is expected that the new ore prices will show a reduction of 50 or 75c. a ton over the 1921 schedule, and a reduction in rail rates from the mines to the docks and in vessel rates is also expected. Despite the fact that the prices have not been designated, some ore contracts have been entered into, the price to be whatever is set later. There is little talk regarding the coal strike in the Lake Superior region, as there is plenty of coal at most of the mines, and many operators are now using little coal because of the power made available by numerous hydro-electric plants. The shippers expect, if the pig-iron price continues to advance, that ore will sell at higher prices.

Early estimates place the amount of ore to be moved down the Lakes this year at about 45,000,000 tons—double the amount moved in 1921. There is still considerable ore in stock at most of the underground mines, and there is little likelihood that the underground properties will be worked to the limit this season. The open pits will do their share of the shipping and some of them are now preparing for operation.

The Marquette Range is working on the same basis as last fall, with a number of mines still idle, but several of the Menominee Range properties which were closed all winter are again producing ore. The outlook is far more bright than it was a year ago this time, and the shippers are looking forward to cleaning up some of the surplus which they have been carrying.

Gogebic Range

Newport Mine Shipping—Two Fatal Accidents on Range—Wakefield Pit to Ship

From Our Special Correspondent

Ironwood—The Newport mine of the Steel & Tube Co. has started shipping ore to the Ashland docks. Orders for the shipment of but one cargo have been received. The Ironton mine expects to ship at the rate of 25,000 tons per month, and a steam shovel is being put on the stockpile.

Two fatal accidents occurred recently. At the Yale mine a miner was electrocuted while retimbering a haulage drift. At the Montreal a miner was struck by falling ground, receiving fatal injuries.

The Wakefield pit of M. A. Hanna & Co. has orders to ship 100,000 tons of ore. Sixty men are at work laying tracks and stripping. One steam shovel and two locomotives are now in use, and will soon be manned by a night crew also.

MINNESOTA

Mesabi Range

St. James Mine To Be Reopened—Lamberton Dryer Being Remodeled—Webb Mine to Resume

Aurora—Ore from the stockpile at the Meadow-Fowler mine, formerly operated by the Cleveland-Cliffs Iron Mining Co. is being shipped daily to the docks.

Preparations for reopening the St. James mine, operated by the McKinney Steel Co., are being pushed to completion. No work of any magnitude has been done since last summer.

Virginia—The Poco Iron Co. has contracted with the Cole and McDonald Exploration Co. for drilling its property in S. 17 T. 58 R. 17.

Chisholm—The Oliver Iron Mining Co. is preparing to build a concrete and steel bridge over the highway between Chisholm and Buhl to serve the stripping trains from the Frazer pit and for the ore trains later.

Hibbing—The drying plant at the Lamberton mine, operated by Butler Bros., is being remodeled. All of this work has been in charge of the engineering department of the Allis-Chalmers Manufacturing Co.

The Webb mine, of the Shenango Furnace Co., will resume operations May 1. Preparations for reopening are under way. It is planned to ship from the stockpile. About 150 men will be employed.

Buhl—The Interstate Iron Co. will drill some of its property in this locality, which was recently acquired from the state under the new law which provides for granting leases to the highest bidder.

ALABAMA

Sloss Sheffield's Mine at Bessemer Preparing to Resume—Raimund Mine Increasing Work

BY GEORGE HUNTINGTON CLARK

Birmingham—As the third quarter of April is ended, iron production in Alabama continues on a steady, upward trend, at a rate of increase called for by an again advanced sale price, and more active market demands, together with heavier reduction in accumulated stocks.

As against five active furnaces in July of 1921. there are now eighteen stacks in blast, an increase of about 265 per cent, carrying a corresponding increase of employment.

Reflecting these conditions, the second furnace of the Republic Iron & Steel Co. at Thomas, is now being dried out, and will be making iron on or before May 1, making that company's second active stack there.

The blast furnace of the Sloss-Seffield Steel & Iron Co. at North Birmingham is again in operation, and it is stated that the Philadelphia furnace of the same company at Florence, on the Tennessee River, is being made ready to go in as soon as possible.

Work is said to have started getting the slope ready at the Sloss red ore mine at Bessemer, which will be the last of the major red-ore mines of the district to resume.

Work has also been resumed preparing the second slope of the Raimund red ore mine of the Republic Iron & Steel Co., indicating a much more rapid return to normal than was anticipated earlier in the year.

The bituminous coal strike seems not as yet to have affected the state as regards operation, and no considerable amount of outside business has been so far attributed by operators to strike conditions existing in outside territory.

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
20	12.625	30 00	31 00	5.10@5.35	5.05	4.925
21	12 625	30.875	31.75	5 10@5.35	5.10@5 15	4.95
22	12.625	30.75	31.50	5.10@5.35	5.10@5.15	4.95@5.00
24	12.625	30.25	31.125	5 25@5.40	5.15@5.20	5 00
25	12.625	30.375	31.125	5 25@5.50	5.20	5.025
26	12.625	30.375	31.125	5 25@5 50	5 25	5.05

*These prices correspond to the following quotations for copper delivered: 12.875c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
20	59⅛	59¾	64	153⅛	154½	23⅛	22⅝	26⅞	27
21	59⅜	60¼	64	155¾	157¼	23¾	23¼	27	27⅛
22	...	...	...	.....	.....	....	....	....	....
24	59⅜	60⅛	64½	153¼	154¾	24⅛	23⅝	27⅛	27⅜
25	59	59⅝	64½	151½	153	24⅜	23¾	27¼	27⅜
26	59¼	59⅞	64½	152½	154	24⅛	23¼	27⅛	27½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
20	441½	99⅜	68	34¾	24	442	99⅜	68⅜	34¾
21	441¼	99⅜	68¼	34¾	25	442¼	99⅜	68	34½
22	441¼	99⅜	67⅞	34⅜	26	442	99⅜	67¾	34½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, April 26, 1922

The metal markets have been characterized by a firm tone during the last week, though business generally has not been of large proportions. Producers are encouraged by the continued evidences of returning business prosperity, and no longer feel inclined to sacrifice their product. Metal prices are still away below the general level and could reach much higher figures without being out of line with other commodities.

Copper

Despite reports of large sales of copper at prices as high as 13c., delivered, the market has been at 12⅞c. all week, and few large orders have come to our knowledge. Inquiries were unusually numerous on Saturday and Monday, but they were generally for small tonnages and indicated a desire on the part of consumers not to contract for copper farther ahead than July. Encouraged by the seeming activity, some producers raised their prices to 13c., delivered, on Monday or Tuesday, but plenty of copper remained available at the 12⅞c. level. In fact, some consumers situated near New York, or where the milling-in-transit rate applies, have bought copper for 12.75c. delivered; one fairly good sized order was placed at that level. The undertone is strong, and it would not be surprising to see slightly higher prices soon. Forward delivery commands a premium, and last quarter copper could probably not be obtained for less than 13c., with most producers disinclined to quote.

The export market has continued satisfactory though quiet. Prices have ranged from 13@13⅛c., c.i.f. Europe.

Lead

The American Smelting & Refining Co. advanced its official contract price of lead from 5 to 5.10c., New York, on April 20; and to 5.25c. on April 24.

Conditions which have existed for the last two or three weeks in the lead market continue. Prompt lead is even harder to obtain than before, but, on the other hand, consumers are quieting down and are not so insistent that they be immediately supplied. With practically all producers sold out of current production, and unwilling to contract for delivery later than May, the producers' market may be said to be largely nominal, and it is particularly difficult to establish quotations which represent average sales. The market has largely been set by small lots, many of the transactions being made through dealers. The price of lead has advanced faster than most of those who have the good of the industry at heart would like to see, but the advance has been a genuine one and caused entirely by a large and insistent demand.

The St. Louis price has strengthened along with that in the East and is so high that it does not pay, in most instances, to ship lead to New York. Some of the high-cost lead which has been held in stock for the last year or so has been sold, but has in no sense dampened the demand, and consumers appear ready to take all that is released. Lead was obtainable in Chicago during almost all the week at 5.25c.

Zinc

The advance in zinc carried the market above 5c., a level that has not been reached since almost exactly a year ago. Some producers have been active in the market, whereas others report no sales for the week. A feature of the market was the recurrence of export business, metal being sold to Japan and to Europe. Zinc sold to Europe from St. Louis is shipped by rail to Gulf ports. In general, sales were all for fairly prompt shipment during the next thirty days. June delivery commanded a 2½-point premium, though some producers asked 5 points. Today it would be difficult to secure prompt metal below 5.05c. High-grade zinc has been moving in satisfactory volume at 6c., with 30c. per 100 lb. freight allowance. The New York market is 35 points above St. Louis.

Tin

Tin has been in somewhat better demand, especially from tin platers, who are buying more for prompt delivery. Reports to the effect that some of the Far Eastern stocks were released caused a slight recession in London, but the news was largely offset by American buying. At the beginning of the week, the New York price for Straits was about ⅛c. below London parity, but the market is now back to import cost. The tin market seems likely gradually to move to higher levels.

Arrivals of tin, in long tons: April 19, Liverpool, 25; 24th, Straits, 1,155; 25th, London, 25.

Gold

Gold in London: April 20th, 93s. 6d.; 21st, 93s. 5d.; 24th, 93s. 5d.; 25th, 93s.; 26th, 93s. 3d.

General stock of money in the United States April 1: Gold coin and bullion, $3,750,617,539; standard silver dollars, $367,261,851; subsidiary silver, $272,329,258; United States notes, $346,681,016; Federal Reserve notes, $2,521,963,710; Federal Reserve Bank notes, $97,443,400; National Bank notes, $752,679,422; total, $8,108,976,196. Circu'ation per capita, $49.81, compared with $57.51 a year ago. Gold and silver stocks increased during the month by about $37,000,000 and outstanding notes decreased by about $5,000,000.

Foreign Exchange

Foreign exchanges have been generally stronger during the last week, and some new high points were reached, among these being Norwegian and Canadian currencies. On Tuesday, April 25, francs were 9.31c.; lire, 5.405c.; marks, 0.37875c.; and Canadian dollars, 98.94c.

Silver

Silver reacted somewhat after the sharp advance of April 19, but has steadied at a new high level for the year. The market continues uncertain, with Far Eastern speculation the chief factor. Under these conditions it is impossible to forecast the future of silver.

Mexican Dollars—April 20th, 52¼; 21st, 52¼; 22d, 51¾; 24th, 52¼; 25th, 51¾; 26th, 51¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5@5½c. for the week. Market strong; difficult to obtain metal below 5½c.

W.C.C. brand, 6@6¼c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6¾@7c.

Arsenic—6.75@7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver — $55@$57 per 75-lb. flask.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of April 8.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, Titanium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of April 8.

Zinc and Lead Ore Markets

Joplin, Mo., April 22 — Zinc blende, per ton, high, $31.75; basis 60 per cent zinc, premium, $31; Prime Western, $30@$29; fines and slimes, $28@$26; average settling price, all grades of blende, $27.41.

Lead, high, $69.55; basis 80 per cent lead, $69@$70; average settling price, all lead ores, $67.62 per ton.

Shipments for the week: Blende, 9,927; lead 1,332 tons. Value, all ores the week, $362,130.

Purchases this month have taken up approximately 10,000 tons of reserve blende, all that could be secured on the price level prevailing. Demand is strong enough to present an acute competition for the weekly production. Though price quotations are reported lower than last week on some grades, purchases at the prices quoted were limited, the bulk of the transactions being close to the figures of last week. Sellers took it as an attempt to show a weakness where none exists, and some declined to accept the lower offerings, later selling as last week.

Platteville, Wis., April 22—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $69 per ton. Shipments for the week: Blende, 421 tons. Shipments for the year: Blende 5,028; lead ore, 720 tons. Shipped during the week to separating plants: 752 tons blende.

Non-Metallic Minerals

Prices are unchanged from those in the issue of April 8, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc.**

Mineral Products

Sodium Nitrate—$2.90@$3 per 100 lb. ex vessel, Atlantic ports.

The prices of **Copper Sulphate, Potassium Sulphate** and **Sodium Sulphate** are unchanged from the issue of April 8.

Ferro-Alloys

Ferromanganese — Domestic prices have advanced $5 to $67@$69, f.o.b. furnace.

Ferrosilicon—50 per cent grade, $56@$58 per gross ton, f.o.b. works.

Ferrovanadium—$3@$3.50 per lb. of V contained.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotungsten,** and **Ferro-uranium** are unchanged from the issue of April 8.

Metal Products

Copper Sheets — New York base, 19.25c. per lb.; wire, 14@14.25c.

Lead Sheets and **Zinc Sheets** are unchanged from the prices quoted April 8.

Nickel Silver—26.25c. per lb. for 18 per cent nickel, Grade "A" sheets.

Yellow Metal—Dimension sheets and sheathing, 16.75c. per lb.; rods, 13.75c.

Refractories

Magnesite Brick—First quality, 9-in. straights, $55 per net ton, f.o.b. Pennsylvania works.

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, and **Silica Brick** are unchanged from the prices quoted April 8.

The Iron Trade

Pittsburgh, April 25, 1922

Until Thursday or Friday of last week the tide of non-union striking in the Connellsville coke region seemed on the whole to be increasing slightly, but since then production has probably increased a trifle, and a common view is that by about May 1 the strikers will begin returning in increasing numbers. These non-union workers are not accustomed to long strikes, as are the regular members of the United Mine Workers. The steel industry as a whole is producing more steel than on March 31.

Anticipation of the coal strike produced extra buying of steel products in February and March, and now the realization is producing more buying, making the steel market strong. Sheets were recently advanced $3 a ton, and there is now a considerable volume of buying at the new prices, despite the heavy covering that occurred at the old prices.

Curtailment in supplies of Connellsville coke has affected production of sheet bars in particular. Despite the fact that sheet bars were $29 in March, it is impossible now to buy at under $33, if at that price.

Pig Iron — Merchant furnaces are nearly all out of the market, and no regular prices can be quoted. It is established that pig iron cannot be bought at less than $22, Valley basis, for any grade, an advance of $3 to $4 a ton since April 1. Several furnaces are banked.

Coke

Connellsville—Furnace, no offerings; foundry, occasional sales at $6.25.

Transvaal Gold Production

The following table summarizes Transvaal gold production since 1917. Production in 1922 was seriously affected by labor trouble.

RAND GOLD OUTPUT 1917—1922, IN FINE OUNCES

	1922	1921	1920	1919	1918	1917
January	639,728	651,593	670,503	676,059	714,183	782,631
February		558,137	625,330	636,728	659,759	721,324
March		671,123	707,036	712,379	696,281	787,091
April	.....	681,382	686,979	694,944	717,099	742,774
May	.....	687,776	699,041	724,995	741,217	729,388
June	.....	678,490	715,957	702,379	727,696	759,725
July	.....	689,555	736,099	725,497	736,199	757,894
August	.....	711,526	702,083	706,669	740,210	756,650
September	.....	691,026	682,173	698,558	708,206	738,23g
October	.....	707,000	662,472	723,722	679,764	751,290
November	.....	704,236	633,737	677,970	658,701	722,839
December	.....	681,847	632,215	650,191	641,245	722,419

The Trend of Canadian Gold Production

In the current year Canada should produce a million ounces of gold for the first time in her history. This compares with a normal production in the United States of from two to five million ounces per year, depending upon industrial conditions. The trend of gold production in the territory occupied by our northern neighbor is interesting. Data for the three leading gold-producing provinces for the last twelve years is shown in the table below.

In 1910, British Columbia was the leading producer, though closely seconded by the Yukon that being the time when the placer deposits of the Far North were being worked with great intensity. Both the British Columbia and the Yukon production began to recede after the high figures of 1913, owing first to a dearth of miners caused by war demands, and then by high costs and the gradual depletion of the developed deposits. However, the Porcupine district, in northern Ontario, began to come to life about 1912, and rapidly assumed its present commanding lead among the Canadian provinces. It is now producing about three-quarters of the total dominion output. Most of the gold so far has come from Porcupine, but the Kirkland Lake district is becoming of importance, and other regions are almost sure to demand consideration within a few years. The Ontario gold production is likely to increase for many years to come. Without the discoveries in this province, the gold output of Canada would have been as disappointing in the last five years as have been the figures for this country.

GOLD PRODUCED IN CANADA, IN OUNCES

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
British Columbia	261,386	238,496	251,815	297,459	252,730	273,376	219,633	133,742	180,163	167,252	124,808	149,397
Yukon	221,091	224,197	268,447	282,838	247,940	230,173	212,700	177,667	102,474	90,705	72,778	65,991
Ontario	3,089	2,062	86,523	219,801	268,264	406,577	492,481	423,261	411,976	505,739	564,995	707,470
All Canada	493,707	473,159	611,885	802,973	773,178	918,056	930,492	738,831	699,681	766,764	765,007	924,374

Mining Dividends for April, 1922

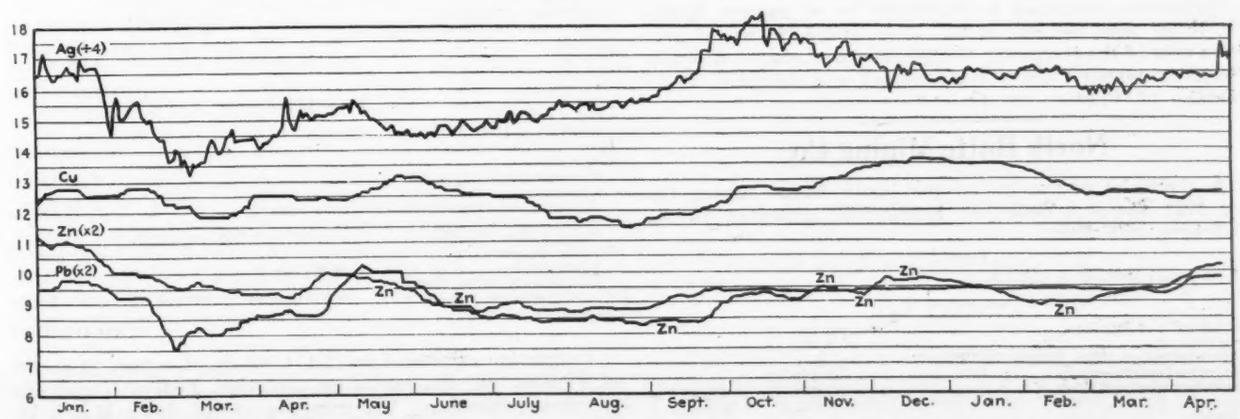
The following dividends were paid by mining and metallurgical companies during April, 1922:

Companies in the United States	Situation	Per Share	Total
American Smelters Sec. pfd. "A"	U. S.	$1.50 Q	$146,071
American Smelters Sec. pfd. "B"	U. S.	1.25 Q	39,855
Arizona Copper Co.	Ariz.	1.00	50,000
Cresson Consolidated Gold	Col.	0.10 QX	122,000
Eagle-Picher Lead, pfd.	Mo., Okla.	1.50 Q	15,000
Homestake Mining, g.	S. D.	0.25 M	62,790
Iron Blossom Consolidated, l.s.	Utah	0.025	25,000
Phelps Dodge Corporation, c.	U. S., Mex.	1.00 Q	450,000
St. Mary's Mineral Land, c.	Mich.	2.00	320,000
Tonopah Belmont Development, s.g.	Nev.	0.05 Q	75,000
Tonopah Extension, s.g.	Nev.	0.05 Q	64,636
Tonopah Mining, s.g.	Nev.	0.075SA,XX	75,000
United Eastern, g.	Ariz.	0.15 Q	204,450
U. S. Smelting, Ref. & Min., pfd., s.	U. S., Mex.	0.75 Q	425,556
Companies in Other Countries			
Asbestos Corporation	Quebec	1.50 Q	45,000
Asbestos Corporation, pfd.	Quebec	1.75 Q	70,000
Dome Mines, g.	Ontario	1.00	476,668
Hollinger Consolidated Gold	Ontario	0.50 4 wks.	246,000
Kerr Lake, s.	Ontario	0.125 Q	75,000
La Rose, s.	Ontario	0.10	150,000
N. Y. and Honduras Rosario, g.s.	Honduras	0.25 Q	50,000
Nipissing, s.	Ontario	0.15 Q	180,000
Wright-Hargreaves, g.	Ontario	0.025 Q	68,750

Q, quarterly; M, monthly; SA, semi-annually; X, includes 5c. extra; XX, includes 2.5c. extra; g, gold; s, silver; l, lead; c. copper.

The April list of dividends again shows some additions over that for January, thus reflecting the better conditions which the mining industries in general are enjoying. The dividend on Arizona Copper is a $1 distribution made on the 50,000 shares of unissued Phelps Dodge stock which was turned over to the Arizona Copper Co., Ltd., in return for the properties of that company. Iron Blossom again paid 2.5c., following its resumption of dividend disbursements last December. The St. Mary's Mineral Land dividend indicates that the Michigan copper country is again coming to a profitable operating basis. The Dome distribution of $1 is a capital disbursement made in lieu of the regular quarterly dividend of 25c. La Rose paid 10 per cent, resuming payments after a lapse of three years. The New York & Honduras Rosario company's last dividend was in January, 1921. Wright-Hargreaves, the latest of the Ontario gold producers to enter the dividend ranks, seems to be on a quarterly basis, though this second dividend is only half of that paid in January. The stock has recently been listed on the Standard Stock Exchange in Toronto. It has always been closely held.

Prices of New York Copper, Silver and Lead, and St. Louis Zinc 1921 and 1922



COMPANY REPORTS

Phelps Dodge Corporation

A report of operations of the Phelps Dodge Corporation for 1921 shows a loss of $8,539,068.22, according to the following income account:

Income		
Sales of metals, fuel, and merchandise	$18,491,602.06	
Income from investments and miscellaneous earnings	280,720.37	$18,772,322.43
Expenses		
Cost of metal, fuel and merchandise	$21,313,031.18	
Depreciation	1,825,746.07	
Depletion	2,512,414.89	
Expenditure during suspension of operations	838,193.50	
Interest	822,005.01	27,311,390.65
Loss for the year 1921		$8,539,068.22

Balance sheet as of Dec. 31, 1921, follows:

ASSETS		
Mines and mining claims	$158,635,915.12	
Plants and miscellaneous properties	33,861,019.48	$192,496,934.60
Stripping expense, chargeable to future operations	$7,098,317.47	
Ores and concentrates	3,692,552.41	
Metals on hand—copper at cost, silver and gold at market	3,752,056.89	
Copper sold Copper Export Association, Inc. (at cost, less amount received on account)	2,873,045.50	
Insurance, interest, and other expenses prepaid	447,966.64	
Materials and supplies	4,163,030.47	
Merchandise (P. D. Mercantile Co.)	1,285,317.26	
Accounts receivable	3,351,134.16	
Investments	5,205,095.26	
Cash	3,292,037.97	35,161,554.03
		$227,658,488.63
LIABILITIES		
Capital stock, authorized and issued, 500,000 shares at $100		$50,000,000.00
£316,530 outstanding preference stock of the Arizona Copper Co., Ltd., to be retired prior to Sept. 30, 1926		1,540,446.00
Accounts payable, taxes and interest accrued	$17,003,303.84	
Dividend payable Jan. 3, 1922	500,000.00	17,503,303.84
Reserve for depletion	$46,255,404.88	
Reserve for depreciation	11,773,655.17	58,029,060.05
Surplus: Balance Dec. 31, 1920	$120,027,172.91	
Less adjustment of mines and depletion reserve to Government valuation	20,722,294.36	
	$99,304,878.55	
Surplus acquired through purchase of the Arizona Copper Co., Ltd., properties	11,669,868.41	
	$110,974,746 96	
Loss for year 1921, per income account	8,539,068.22	
	$102,435,678.74	
Dividends	1,850,000.00	100,585,678.74
		$227,658,488.63

Production amounted to 28,639,995 lb. of copper, 5,303,846 lb. of lead, 852,925 oz. of silver, and 5,741 oz. of gold from ores of the company; 134,999,025 lb. of copper was sold (includes copper from other sources) and delivered at an average of 12.959c. net f.o.b. New York.

North Butte Mining Co.

A report of operations of the North Butte Mining Co. for 1921 shows a deficit of $326,575.70 according to the following statement:

INCOME		
Income from copper, silver, and gold		$96,097.34
EXPENDITURES		
Mining and development	$211,576.15	
Freight on ore	4,985.04	
Concentrating, smelting, freight on bullion, refining and selling expense	88,350.82	
General expenses and taxes	117,761.03	422,673.04
Deficit		$326,575.70

Balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS		
Mining property	$9,184,801.19	
Liberty Loan Bonds	120,000.00	
War savings stamps and certificates	1,082.60	
Granite Mountain shaft construction	150,260.15	
East side development	494,931.52	
Deferred development	368,608.27	
Cash	55,123.87	
Accounts receivable	18,370.02	
Supplies at mine	19,763.71	
Copper to company's credit with United Metals Selling Co. and Copper Export Association, Inc.	1,577,176.30	$11,990,117.63
LIABILITIES		
Capital stock	$6,450,000.00	
Dividends unclaimed	1,033.15	
Accounts payable	15,289.54	
Copper Export Association, Inc.	489,398.60	
Advances on metal	672,112.92	
Reserve for ore depletion	3,075,188.02	
Surplus	1,287,095.40	
Balance Jan. 1, 1921	$1,750,626.17	
Deficit for year	326,575.70	
	$1,424,050.47	
Deduct for ore depletion	136,955.07	$11,990,117.63

Production for the year amounted to 1,229,600 lb. of copper, 34,535.76 oz. of silver and 78 oz. of gold. A total of 4,565,169 lb. of copper was sold at 13.753c. per lb.

Inspiration Consolidated Copper Co.

A report of the operations of the Inspiration Consolidated Copper Co. for 1921 shows a net loss of $1,790,421.18 according to the following income account:

Sales of copper			$8,636,498.34
Expenses			
Mining, including development	$728,919.34		
Reduction, including transportation	850,719.67		
Refining, selling, transportation	492,627.83		
Administration and Federal taxes	166,223.95		
Copper on hand at beginning of year	9,746,476.63		
	$11,984,967.42		
Less copper on hand at end of year	2,799,021.35		9,185,946.07
			$549,447.73
Depreciation on buildings and equipment			166,593.33
Interest paid			97,414.90
			$813,455.96
Income from investments			112,101.00
Operating loss			$701,354.96
Expenditures during suspension of operations			1,089,066.22
Balance, net loss for year			$1,790,421.18

Balance sheet as of Dec. 31, 1921, follows:

ASSETS			
Fixed			
Mines, mining claims and lands	$16,934,268.04		
Buildings and equipment	9,519,619.21		
Investments in sundry companies	902,670.01		
			$27,356,557.26
Current			7,055,473.78
			$34,412,031.04
LIABILITIES			
Capital stock			
Authorized 1,500,000 shares of $20 each			
Issued 1,181,967 shares			$23,639,340.00
Reserve			
For depreciation			3,413,945.23
Current			
Accounts and wages payable and taxes accrued			1,112,516.25
Surplus			
Balance, Dec. 31, 1920	$8,036,650.74		
Net loss for year			
Operating loss	$701,354.96		
Expenditure during suspension of operations	1,089,066.22	1,790,421.18	6,246,229.56
			$34,412,031.04

Production amounted to 15,174,768 lb. of copper at a cost of 15,208c. per lb., excluding depletion, Federal taxes and shutdown expenses. The company closed down March 31, 1921, and reopened Feb. 15, 1922

New Cornelia Copper Co.

A report of the operations of the New Cornelia Copper Co. for 1921 shows a net deficit of $360,102.80. No dividends were paid. Production amounted to 20,198,382 lb. of copper. A statement of income and expenditures follows:

INCOME		
Total earnings on metals	$2,643,127.87	
Dividends	5,590.00	
Interest	73,321.90	
Other income	15,101.33	
		$2,737,141.10
EXPENDITURES		
Operating expenses	$1,422,315.40	
Salaries, office and general expenses	43,098.41	
Freight, refining and marketing	297,138.19	
State and Federal taxes	492,439.57	
		$2,254,991.57
Operating profit		$482,149.53
Less		
Depreciation	$372,420.40	
Ore depletion	469,831.93	
		$842,252.33
Net deficit		$360,102.80

Balance sheet, Dec. 31, 1921, follows:

ASSETS		
Mining property	$28,075,880.55	
Less reserve for ore depletion	3,680,692.07	
		$24,395,188.48
Construction	$6,728,076.03	
Less reserve for depreciation	2,793,796.02	
		3,934,280.01
Investments (at cost)		
New Cornelia Co-operative Mercantile Co. stock	$100,000.00	
Ajo Improvement Co. stock	60,500.00	
Liberty Bonds, Treasury certificates and W. S. stamps	650,184.00	
Ajo School District bonds	94,500.00	
Other securities	61,200.00	
		966,384.00
Notes receivable		147,000.00
Accounts receivable		940,300.17
Cash		746,887.19
Supplies		571,858.30
Copper on hand		3,521,518.13
Deferred charges to operations		248,661.99
Items in suspense		28,188.49
		$35,500,266.76
LIABILITIES		
Capital stock		$9,000,000.00
Accounts payable		1,661,310.58
Reserve items		54,842.84
Surplus		24,784,113.34
Earned surplus, Dec. 31, 1920	$2,948,600.04	
Deficit year 1921	360,102.80	
Earned surplus, Dec. 31, 1921	2,588,497.24	
Paid-in surplus, Dec. 31, 1921	22,195,616.10	
		$35,500,266.76

Copper on hand estimated at 12½c. per lb.

Copper on hand Dec. 31, 1921, amounted to 16,246,819 lb., exclusive of metal held by Copper Export Association.

Callahan Zinc-Lead Co.

A report of the operations of the Callahan Zinc-Lead Co. for 1921 states that no production was made during the year. Financial statement follows:

INCOME		
Miscellaneous income, rent and interest		$10,117.69
EXPENDITURES		
Property maintenance and development	$115,580.89	
General and administrative expenses	50,815.60	166,396.49
Operating deficit for the year		$156,278.80
Cash proceeds of sales of treasury stock		381,792.84
		$225,514.04
Current surplus, Dec. 31, 1920		279,055.18
		$504,569.22
Deduction from current surplus		
Patenting of claims		525.03
Current surplus at Dec. 31, 1921		$504,044.19

Current assets Dec. 31, 1921, were $257,334.07, and current liabilities, $12,134.63. Capitalization, 500,000 shares, $10 par value, of which 464,990 shares have been issued.

To facilitate operations, it was deemed advisable to effect a consolidation of the Chicago-Boston and the Kill Buck properties. The Galena Mining Co. was therefore incorporated, with a capitalization of $2,500,000 (par value $1), and its stock was exchanged, on a share-for-share basis, for Chicago-Boston and Kill Buck stock. The Callahan Zinc-Lead Co. owns 1,551,058 shares.

Nipissing Mines Co., Ltd.

A report of the operations of the Nipissing Mines Co., Ltd., for 1921 shows dividend payments of $969,199.26. Production was 3,156,775 oz. of silver, which cost 28.5c. per oz., compared with 37.4c. in 1920. Reserves stand at 3,004,939 oz. Nipissing Mines Co., Ltd., is a holding company for the Nipissing Mining Co., Ltd., and is capitalized at $6,000,000.

The Nipissing Mining Co., Ltd., account shows shipments of 3,016,760 oz. of silver, of net value $1,745,411.07. Cost of production was 28.534c. per oz. Operating account follows:

Gross settlements:			
1920 ore and bullion (shipments paid for in 1921)			$724,493.06
1921 ore and bullion (shipments paid for in 1921)			1,837,143.32
Gross settlements for the year			$2,561,636.38
Gross value of ore, bullion and residue at mine, Dec. 31, 1921			1,031,047.07
			$3,592,683.45
Less gross value of custom ore purchased		$93,406.25	
Gross value of inventory Dec. 31, 1920		1,629,710.79	1,723,117.04
Gross value of 1921 ore—Nipissing production			$1,869,566.41
Cost of mining and all other expenses (including smelter deductions and treatment on settlements of 1921 ore and accrued charges on ore, bullion and residue at mine)		$1,015,622.70	
Less other income at Cobalt			
Ground rents	$13,581.15		
Interest, discount and exchange	101,217.23		
Miscellaneous income	44.42	114,842.80	
Net cost of production			900,779.90
Net income for 1921 production			$968,786.51
Add interest on bonds			130,954.49
			$1,099,741.00
Less cost and work on outside properties			130,541.74
Net profit			$969,199.26
Surplus, Jan. 1, 1921			3,817,043.68
			$4,786,242.94
Less dividends declared and paid during 1921		$575,000.00	
Dividend payable Jan. 1922		360,000.00	935,000.00
Net surplus			$3,851,242.94

Current assets on Dec. 31, 1921, were $2,536,504.33; current liabilities, $568,880.41.

Jim Butler Tonopah Mining Co.

A report of the operations of the Jim Butler Tonopah Mining Co. for 1921 shows a net profit of $15,384.07. Receipts and disbursements follow:

Balance of cash in banks, Dec. 31, 1920			$918.03
Receipts			
On account of shipments of ore by lessees		$69,955.31	
Interest received on bank deposits		15.79	
Secured loan made by Tonopah Belmont Development Co.:			
Sept. 28, 1921	$28,044.11		
Dec. 31, 1921	17,858.73		
		45,902.84	
Other collections		2,283.18	
			$118,157.12
			$119,075.15
Disbursements			
Operation of mine and conduct of business		$62,104.25	
Income tax for 1920 and additional income tax for prior years		17,160.98	
Net disbursements in respect of quarter interest in:			
Belmont Shawmut Mining Co.	$26,054.84		
Less one-quarter net proceeds of ore during 1921	9,851.60		
		16,203.24	
Belmont Wagner Mining Co.	$31,749.16		
Less one-quarter net proceeds of ore during 1921	13,140.09		
		18,609.07	
			$114,077.54
Balance of cash in banks Dec. 31, 1921			$4,997.61

The ore production of the property was entirely from leases and aggregated 8,518.3 dry tons, with a gross metal content of 1,306.145 oz. of gold and 129,630.84 oz. of silver. The gross value of the ore was $156,613.83.

MINING STOCKS

Week Ended April 22, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	63	62	62½	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	3⅜	3⅜	3⅜	.....	....
Allouez	Boston	26½	26	26	Mar. '19	1.00
Anaconda	New York	54⅛	52¾	54⅛	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3⅜	3	3⅜	.....	....
Ariz. Com'l	Boston	9⅛	9	9⅛	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*19	*20	.....	....
Bingham Mines	Boston	15½	15½	15½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	60⅜	58½	59½	Mar. '22, Q	0.50
Calumet & Hecla	Boston	278	273	275	June '20, Q	5.00
Canada Copper	N. Y. Curb	*65	*40	*50	.....	....
Centennial	Boston	12	12	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	37⅜	36⅜	37½	Mar. '21, Q	0.50
Chile Copper	New York	19⅜	18⅜	19⅜	.....	....
Chino	New York	29⅜	28½	28⅝	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*33	*31	*33	.....	....
Con. Arizona	N. Y. Curb	*10	*4	*10	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	....	....	1¼	.....	....
Copper Range	Boston	44⅞	43⅛	44	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1 1/16	1 1/16	1¼	.....	....
Davis-Daly	Boston	8⅛	7⅛	8⅛	Mar. '20, Q	0.25
East Butte	Boston	12	11½	11⅞	Dec. '19, A	0.50
First National	Boston Curb	*95	*85	*86	Feb. '19, SA	0.15
Franklin	Boston	3	2½	2½	.....	....
Gadsden Copper	Boston Curb	1⅛	*98	1⅛	.....	....
Granby Consol.	New York	27½	26½	27	May '19, Q	1.25
Greene-Cananea	New York	31½	28⅜	32	Nov. '20, Q	0.50
Hancock	Boston	3⅛	2⅜	2⅛	.....	....
Howe Sound	N. Y. Curb	3⅜	3⅛	3⅜	Jan. '21, Q	0.05
Inspiration Consol.	New York	42⅜	40¼	41⅜	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†8	†7	7	Sept. '20, K	0.25
Isle Royale	Boston	25	23½	24	Sept. '19, SA	0.50
Kennecott	New York	32⅜	31⅜	32⅜	Dec. '20, Q	0.50
Kewcenaw	Boston	3⅛	2⅛	2⅛	.....	....
Lake Copper	Boston	5⅛	4⅛	4⅛	.....	....
La Salle	Boston	2⅛	1⅞	1⅞	.....	....
Magma Copper	N. Y. Curb	29⅜	28⅜	28⅜	Jan. '19, Q	0.50
Majestic	Boston Curb	*15	*10	*15	.....	....
Mason Valley	Boston	2⅛	?	2⅛	.....	....
Mass. Consolidated	Boston	4⅛	3	3⅛	Nov. '17, Q	1.00
Miami Copper	New York	29⅞	29	29⅞	Feb. '22 Q	0.50
Michigan	Boston	6	2⅜	3	.....	....
Mohawk	Boston	59	57⅛	58⅛	Feb. '22, Q	1.00
Mother Lode Con.	N. Y. Curb	8⅜	7⅞	7⅞	.....	....
Nevada Consol.	New York	18⅛	16⅞	17⅜	Sept. '20, Q	0.25
New Cornelia	Boston	18⅛	17⅛	18⅛	Feb. '22, K	0.25
North Butte	Boston	14	12⅛	13	Oct. '18, Q	0.25
North Lake	Boston	*50	*40	*40	.....	....
Ohio Copper	N. Y. Curb	*14	*12	*13	.....	....
Old Dominion	Boston	26	25⅜	25⅛	Dec. '18, Q	1.00
Osceola	Boston	37	36½	36½	June '20, Q	0.50
Phelps Dodge	Open Mar.	....	†165	....	Apr. '22, Q	1.00
Quincy	Boston	46	45	45½	Mar. '20, Q	1.00
Ray Consolidated	New York	17	16⅛	16⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅜	1⅜	.....	....
St. Mary's Min. Ld.	Boston	46⅛	45	46	Dec. '21, K	1.00
Seneca Copper	Boston	14½	14	14	.....	....
Shannon	Boston	1⅜	1	1⅛	Nov. '17, Q	0.25
Shattuck Arizona	New York	9⅛	8⅞	9⅛	Jan. '20, Q	0.25
South Lake	Boston	*90	*75	*75	.....	....
Superior & Boston	Boston	2⅜	1⅛	1⅛	.....	....
Tenn. C. & C. cfs	New York	12½	11½	12	May '18, I	1.00
Tuolumne	Boston	1	*65	*69	May '13,	0.10
United Verde Ex.	Boston Curb	28⅛	28	28	Feb. '22, Q	0.25
Utah Consol.	Boston	3¼	2⅜	2⅛	Sept. '18,	0.25
Utah Copper	New York	68	65	67	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1⅜	1	1⅛	Dec. '17,	0.30
Victoria	Boston	2⅛	1⅞	2	.....	....
Winona	Boston	2⅛	1⅛	1⅜	.....	....
Wolverine	Boston	12	12	12	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	19⅛	16⅞	19⅛	Mar. '19,	0.50
Internat. Nickel, pfd	New York	79⅛	74⅛	76⅛	Feb. '22, Q	1.50
LEAD						
National Lead	New York	94	91	92	Mar. '22, Q	1.50
National Lead, pfd	New York	110	110	110	Mar. '22, Q	1.75
St. Joseph Lead	New York	14⅛	14	14	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1⅛	1⅛	1⅛	.....	....
ZINC						
Am. Z. L. & S.	New York	17⅛	16⅛	17⅛	May '20,	1.00
Am. Z. L. & S. pfd	New York	44⅜	44⅜	44⅜	Nov. '20, Q	1.50
Butte C. & Z.	New York	7⅛	6⅞	7⅛	June '18,	0.50
Butte & Superior	New York	31⅜	27	31	Sept. '20,	1.25
Callahan Zn-Ld	New York	7⅛	6⅞	7⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	146	145	145	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*45	*40	*40	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

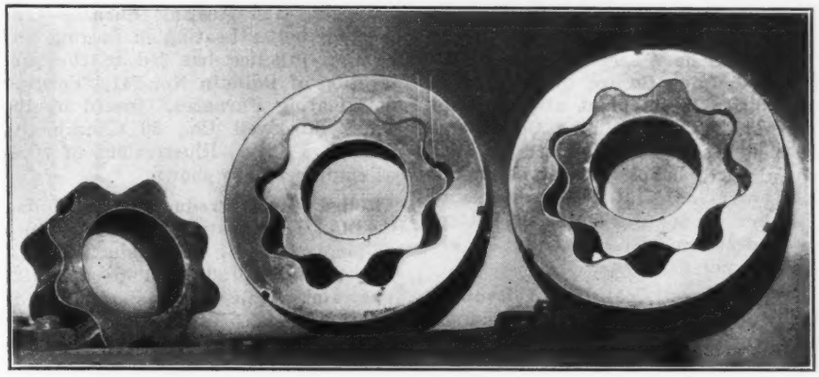
Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press. N. Y.

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅜	⅛	⅜	.....	....
Alaska Juneau	New York	1⅛	1	1⅛	.....	....
Carson Hill	New York	13	13	13	.....	....
Cresson Consol. G.	N. Y. Curb	2⅜	2⅛	2 3/16	Apr. '22, Q, X	$0.10
Dome Extension	Toronto	....	....	*85	.....	....
Dome Mines	New York	27⅛	25	27	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*30	*20	*26	.....	....
Golden Cycle	Colo. Springs	*70	*67	*70	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*14	*8	*10	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.75	9.50	9.70	Apr. '22,	0.05
Homestake Mining	New York	75	72½	73	Mar '22, M	0.25
Kirkland Lake	Toronto	*49	*46	*47	.....	....
Lake Shore	Toronto	2.45	2.30	2.38	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	19.00	18.25	18.75	Jan. '22, K	0.05
Porcupine Crown	Toronto	*29	*26½	*27½	July '17,	0.03
Porcupine V. N. T.	Toronto	*32½	*31	*31	.....	....
Portland	Colo. Springs	*30	*30	*30	Oct. '20, Q	0.01
Schumacher	Toronto	*55	*52½	*55	.....	....
Silver Pick	N. Y. Curb	*17	*14	*17	.....	....
Teck Hughes	Toronto	*57	*50	*56	.....	....
Tom Reed	Los Angeles	*60	*58	*58	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1 7/16	1 7/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*12	*10	*12	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*9	*6	*9	.....	....
Wright-Hargreaves	Toronto	3.00	2.85	2.95	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1⅛	*96	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*36½	*34½	*34½	May '20, K	0.03
Coniagas	Toronto	1.30	1.25	1.30	May '21, Q	0.12½
Crown Reserve	Toronto	*20	*17½	*19	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	4	3	4	Apr. '22, Q	0.12½
La Rose	Toronto	*35½	*31	*33	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*24	*23	*24	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.10	1.00	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6	6⅛	Apr. '22, Q, X	0.30
Ontario Silver	New York	8	7⅛	7	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	0.10
Temiskaming	Toronto	*35	*33	*34	Jan. '20, K	0.04
Trethewey	Toronto	*6½	*4	*4	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*23	*19	*20	.....	....
Cash Boy	N. Y. Curb	....	....	*4	.....	....
Dolores Esperanza	N. Y. Curb	2⅛	2	2⅛	.....	....
El Salvador	N. Y. Curb	*5	*4	*5	.....	....
Jim Butler	N. Y. Curb	*8	*8	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*5	*5	*5	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*12	*8	*12	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1	1⅛	1	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*85	*71	*81	.....	....
Tonopah Extension	N. Y. Curb	1 5/16	1⅛	1 5/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅛	1	1⅛	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1 5/16	1⅛	1 5/16	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*95	*95	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	3½	4	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	24½	23¾	24½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.35	†1.50	....	July '20, Q	0.10
Daly-West	Boston	2	2	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*9	*7	*8	May '20, SA	0.03
Federal M. & S.	New York	....	....	11	Jan '09,	1.50
Federal M. & S. pfd.	New York	40	39¾	40	Mar. '22, Q	1.00
Florence Silver	Spokane	*24	*23	*24	Apr. '19,	0.01½
Grand Central	Salt Lake	†*68	†*56	*57	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6⅛	5⅞	6⅛	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*22	*19	*20	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.50	†2.00	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*7	*7	*7	June '21, I	0.02
Prince Consol.	Salt Lake	*5	*3⅞	*3¾	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*4	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*10	*8	*10	.....	....
South Hecla	Salt Lake	†*60	†*35	....	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*16	*13	*14	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*15	*13	*13	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.37	2.25	2.37	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.80	1.77½	1.80	Dec. '21, Q	0.05
Utah Apex	Boston	3⅜	3¼	3¼	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	44¼	41½	43¾	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp	Montreal	62	62	62	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	80	80	80	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	17⅞	16½	17	Nov. '19, Q	1.00
Texas Gulf	New York	43¾	41½	42	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	59½	56½	58¾	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	97¾	97	97⅝	Mar.'22 Q	1.75
Am. Sm. Sec. pf. A.	New York	92½	92	92½	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	41⅛	38	41½	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	45	44¼	45¼	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

New Rotary Gear Movement Has Many Applications

A number of efforts have been made to devise a motor or compressor movement based on the rotary principle, but until recently all of these have resulted in failure. However, a type of gearing, built on an entirely new principle in mechanics, has been designed by Myron F. Hill, and it is stated that this overcomes the objections that have been presented by other designs. The construction is simple and extremely durable, because it involves only two moving parts, one rolling inside the other.



Hill rotary motor gear

The design comprises two gear wheels; one, a pinion, and the other an annular gear, the latter having one more tooth than the pinion, so that the teeth of one is always in theoretical engagement with the teeth of the other. The gears are mounted on eccentric axes so that the teeth mesh at one point and clear at the opposite point.

To assure contact between the teeth during compression the annular gear is driven, and as a result the gears will maintain efficient compression until the teeth have worn off. This construction steps pressures up through several stages in one mechanical movement between the suction and discharge ports. Used as a pump, the device is stated to be capable of creating a vacuum as nearly perfect as can be measured by a mercury column.

Liquid, preferably oil, is used for sealing purposes. The liquid seal is so applied as to enter the gear spaces as a mist and in such quantities as to keep down the heat of compression substantially and save considerable power in compression. The liquid mist, after discharge, is removed by a centrifugal baffle-plate separator incorporated in the housing with the compressor. The extraction of oil from the air is so complete that no oil can be detected on a cigarette paper held over the discharge port for long periods of time.

The gears appear to be just as tight after long and hard usage and some wear and lost motion as when new. Quantities of sand, scale, and indentures on the teeth have produced no appreciable effect. In other words, treatment that would put a piston and cylinder out of business fails to effect the gears.

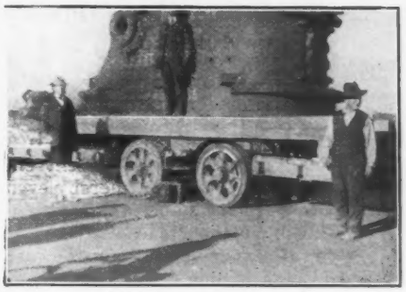
The maximum speed at which the pump can be run has not yet been determined. Those built thus far have operated satisfactorily at 4,200 r.p.m. A tiny air compressor supplied with Hill gears and mounted in the end of a one-third horsepower electric motor was stopped at 370 lb. pressure per square inch to prevent the pipes from bursting.

The gears have been adapted not only to air compressors but also to the following: steam engines; oil and gas engines for autos, airplanes, yachts, ships, and power plants; liquid pumps having a uniform delivery; and ice-making machines. There are many other uses to which the gears may be put, such as providing air for laboratories, gage-testing apparatus and portable air tools, and air pressure pumping. The gears have proved adaptable for any purposes for which the usual piston and cylinder are used, so far as is known and to many uses for which pistons and cylinders are not suited.

The Hill Engineering Co., 163 Remsen St., Brooklyn, N. Y., owns the patent rights upon all these developments, and purposes licensing others for their use and manufacture.

Trucks and Tractors Haul Thirty-Three-Ton Crusher Up 9 Per Cent Grade

The transportation of heavy machines and machinery parts is of considerable interest to mining engineers. A thirty-three-ton rock crusher frame (36 x 48 in. jaw crusher) made by the Traylor Engineering & Manufacturing Co., was purchased by Dudley and Orr for their rock quarry on Mount Franklin near El Paso, Texas. The distance from the railroad unloading point to the quarry was five miles and the altitude over 800 ft. above the railroad. The stripped frame of the crusher was loaded on two special rubber tired trucks and was hauled by two five-ton trucks and two caterpillar tractors. A five-ton truck was in the rear pushing the load. The load was transported in twelve hours over the road leading to the quarry. The steepest grade was 9 per cent.



Rock crusher frame ready for transportation

Repairing a Car Axle Press

A job that is typical of the work being done by oxy-acetylene welders and cutters at mines and smelters is depicted in the accompanying illustrations, which show a 300-lb. hydraulic car axle press before and after being repaired.

Fig. 1 indicates the seriousness of the fracture, showing the broken press in two pieces, and Fig. 2 depicts the press after it was reclaimed by the welder. The latter view might easily be mistaken for a reproduction of an entirely new press, so well executed is the outer finish of the weld, and that its excellence is more than "skin deep" is attested by the satisfactory service the press is now giving under heavy working pressures.

The press shown is the property of the United States Smelting, Refining and Mining Co., at Midvale, Utah. The weld measured from 3¼ in. to 6 in. in depth and was about 6 ft. 3 in. long. The job was executed with one blowpipe and required about 200 lb. of filling material. Oxweld equipment and materials were used.

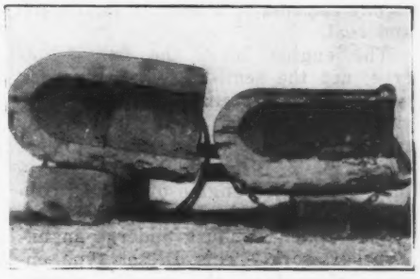


Fig. 1. Fracture of car axle press

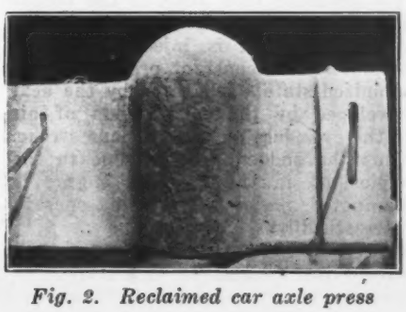


Fig. 2. Reclaimed car axle press

Gasoline-Driven Shovel Offers Low Fuel Cost

The development of a gasoline-operated shovel is distinctly novel, particularly when it embodies the ingenuous method of operating the thrust without the use of an independent engine mounted on the boom whereby even more power is obtainable than with a steam shovel of the same size. After a period of experimentation, the use of a Diesel-type engine has been applied to this shovel. The importance of this announcement lies principally in one outstanding fact, the fuel cost.

It is claimed that the shovel, manufactured by the Bucyrus Co., of South Milwaukee, Wis., and known as the Bucyrus 30-B oil shovel, will use as fuel any cheap, low-grade oil of high heat value which will flow freely. Tests have shown that with fuel oil at 6c. per gallon this machine will consume 1⅜ to 2¼ gal. of fuel oil per hour. This amounts to a fuel cost of 10½c. to 13½c. per hour, or, roughly, between $1 and $1.25 per day of average operation.

The economies thus made possible to a shovel or drag-line operator may be realized by comparison with a steam shovel of the same size. All practical men who read this know that the fuel cost of any shovel differs widely in different sections of the country. Conservatively stated, however, such a shovel will burn about 1½ tons of coal in ten hours. With coal at $6 per ton delivered, this means a daily fuel cost of not less than $9. A saving of $8 per day on fuel alone is thus possible. To this figure may be added several other items thus eliminated—notably, the saving made possible in not having to pay the cost of a team to haul water and coal.

The engine is of the full Diesel type, not the semi-Diesel. It is what is known as a mechanical injection engine, developing 55 hp. at the conservative speed of 360 r.p.m. Its cylinders are 8 in. x 10½ in. It is a heavy-duty, slow-speed engine of rugged construction, adapted well to the severe service which it must undergo in excavation work. This Diesel type engine differs from the gasoline engine principally in that it is a constant-pressure engine, the fuel being burned directly in the cylinders without the aid of a carburetor, spark plug, or outside heating appliances. In the gasoline engine the mixture is taken into the cylinders, compressed, and then ignited by some auxiliary mechanism. The pressure then rises in the nature of an explosion. In the Diesel type engine the fuel is injected into the cylinders at a constant pressure in an atomized state. It is fired by the heat developed by the compression of air in the cylinders on the previous stroke. Thus the sudden pressure due to the explosions in the gasoline engine is eliminated, making the engine operate more steadily.

The machine is furnished as a shovel, a drag-line, a clamshell or a crane.

INDUSTRIAL NOTES

Herbert B. Wolcott was recently appointed representative of the American Manganese Steel Co. in the northern part of Mexico and El Paso County, Tex. He maintains an office in the First National Bank Building, El Paso, Tex.

The General Engineering Co. has received instructions from the Stargo mines of Morenci, Ariz., to proceed at once with the design and construction of a 100-ton plant to treat the ore from the Stargo mines at Morenci. Construction work will start at an early date, and it is expected that the plant will go into operation next September.

Contracts have been awarded by the Metals Refining Co. for the erection of an addition to its plant at Hammond, Ind. The Metals Refining Co. entered the field as a manufacturer of antimonial lead, babbitt and type metals three years ago. Its requirements of lead- and tin-bearing materials, battery plates, lead, tin and solder drosses are 150 tons per day.

The Tennessee Coal, Iron & Railroad Co., after a thorough investigation of the use of pulverized coal in steam generation, has decided to use it in conjunction with blast-furnace gas on new boiler installation at Ensley, Ala. The company has just closed a contract with the Fuller Engineering Co., of Allentown, Pa., for the installation of the complete coal drying, pulverizing, and conveying systems to serve this plant. Also, the burners and feeders for five 834-hp. Stirling boilers designed to operate at 200 per cent of rating.

The pulverized-coal equipment comprises the following:

One 5 ft., 6 in. x 42 ft. indirect-fired rotary coal drier, using blast-furnace gas for heating.

Two 46 in. Fuller-Lehigh gear driven, screen-type pulverizer mills, direct connected to motors.

One Fuller-Kinyon pulverized coal transport system, together with five take-off valves and six bin indicators.

Twenty-five Fuller S-H feeders.

Twenty-five Fuller-type vertical burners.

The boilers will be situated approximately 600-ft. from the pulverizing plant, and the fuel will be conveyed directly from the pulverizer to the boiler bins by means of the Fuller-Kinyon transport system. The fuel will be diverted from the main line to the individual service bins through distributing valves and branch lines. The bins will be equipped with automatic bin indicators which will keep the operator advised at all times as to the fuel conditions in the service bins.

The feeders will be similar to the Fuller S-H type which have proved satisfactory in a number of installations in other steel plants.

TRADE CATALOGS

Oil and Asphalt Testing Apparatus—The Braun Corporation, Los Angeles, Cal., has just issued catalog 189, "Oil and Asphalt Testing Apparatus," which illustrates, describes, and gives prices on various devices used in the testing of these minerals.

Steel Axles—The Pollak Steel Co., with general offices at Cincinnati, Ohio, has issued a 194-page data book relative to the specifications for industrial and mine car axles. A number of useful tables and general rules are included.

Forging and Heating Furnace—The need for better heating in forging and forming practice has led to the preparation of Bulletin No. 241, "Forging and Heating Furnaces," issued by the W. S. Rockwell Co., 50 Church St., New York City. Illustrations of typical equipment are shown.

Rolled Steel Products—The Pollak Steel Co., Cincinnati, Ohio, has issued a 136-page "Rolled Steel Products Book," which contains profiles, tables, and data appertaining to the manufacture of angles, I-beams and other various shapes of rolled-steel products that are used for general industrial purposes.

Thrust Bearings — The Kingsbury Machine Works, of Philadelphia, Pa., have recently issued Catalog C, "Kingsbury Thrust Bearings." The catalog has been completely rewritten and includes much new matter of considerable value to engineers in general and to users of thrust bearings.

Crushing Rolls—C. G. Buchanan Co., Inc., 90 West St.. New York City, has issued Bulletin No. 13, which contains descriptions of Type C Buchanan crushing rolls. Several tables showing the capacity in cubic feet per hour of rolls of different width of face and at various speeds are also given.

Material Handling Machines—A thirty-two-page catalog, No. 4, issued by The Barber-Greene Co., Aurora, Ill., illustrates and outlines the specifications of the Barber-Greene material-handling machines, which consist of self-feeding bucket loaders, portable belt conveyors, and permanent belt conveyors for the handling of all kinds of bulk material.

Power Transformers—The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has issued bulletin No. 1108 on "Power Transformers." There has been a steady increase in the size of power transformers, and with the growth of large transmission systems, voltages which a few years ago were considered impracticable are now generally employed. The bulletin, comprising thirty-two pages, details and illustrates the various types of apparatus.